EO/US
PCT/AU98/00868

PAT_NT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

United States Patent and Trademark Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing: 29 April 1999 (29.04.99)	
International application No.: PCT/AU98/00868	Applicant's or agent's file reference: 40118987
International filing date: 19 October 1998 (19.10.98)	Priority date: 21 October 1997 (21.10.97)
Applicant: YIP, Brandon et al	

1. The designated Office is hereby notified of its election made:

   [X] in the demand filed with the International preliminary Examining Authority on:

   23 March 1999 (23.03.99)

   [ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was [ ] was not

   made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland** Facsimile No.: (41-22) 740.14.35	Authorized officer: J. Zahra Telephone No.: (41-22) 338.83.38

Form PCT/IB/331 (July 1992)

2580524

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 98/00868

A.	CLASSIFICATION OF SUBJECT MATTER
Int Cl^{6}:	G02C 7/10, G02B 1/10, 1/11

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC: G02C 7/10, 7/02, 7/08, 7/14, G02B 1/10, 1/11, 5/22, 5/26, B29D 11/-, C23C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WPAT, JPAT, USPM: IPC as above with keywords COAT:, ABSORB:, ASYMMETRIC, SUNGLASS:, TINT:, COLOR:, COLOUR:, LENS, ANTIREFLECT:, ANTI() REFLECT:

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P, X	US 5694240 A (STERNBERGH) 2 December 1997 Column 1, line 9 - column 6, line 22	1-6, 16-17, 21
X	WO 96/04216 A (BAUSCH & LOMB INCORPORATED) 15 February 1996 Whole document	11-6, 16-17, 21
X	US 5407733 A (BJORNARD et al.) 18 April 1995 Whole document	1-6, 16-17, 21

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
4 November 1998	13 NOV 1998

Name and mailing address of the ISA/AU	Authorized officer
AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No.: (02) 6285 3929	RAJEEV DESHMUKH Telephone No.: (02) 6283 2145

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5135298 A (FELTMAN) 4 August 1992 Whole document	1-6, 16-17, 21
X	US 4802755 A (HENSLER) 7 February 1989 Whole document	1-6, 16-17, 21
X	US 4793669 A (PERILLOUX) 27 December 1988 Whole document	1-6, 16-17, 21
X	US 3990784 A (GELBER) 9 November 1976 Whole document	1-6, 16-17, 21
X	US 3679291 A (APFEL et al.) 25 July 1972 Whole document	1-6, 16-17, 21

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 98/00868

Box I **Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)**

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. [ ] Claims Nos.:
   because they relate to subject matter not required to be searched by this Authority, namely:

2. [X] Claims Nos.: 42
   because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

Claim 42 does not comply with PCT rule 6.2 (a).

3. [ ] Claims Nos.:
   because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a)

Box II **Observations where unity of invention is lacking (Continuation of item 2 of first sheet)**

This International Searching Authority found multiple inventions in this international application, as follows:

1. [ ] As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims
2. [ ] As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. [ ] As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. [ ] No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest [ ] The additional search fees were accompanied by the applicant's protest.

[ ] No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU 98/00868

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member					
WO	9604216	AU	29671/95	CA	2196283	EP	772572
		US	5729323				
US	5407733	CA	2066043	EP	495979	US	5091244
		WO	9202364	EP	602153	WO	9304993
US	3990784	CA	1036853	DE	2524461	FR	2273777
		GB	1517374	JP	51016940		

END OF ANNEX

Replaced by Article 34 Amd

AMENDED CLAIMS

[received by the International Bureau on 14 December 1998 (14.12.98);
original claims 1-42 replaced by amended claims 1-40 (7 pages)]

1. An optical lens that does not substantially distort colour vision including
an optically clear lens element; and
a light absorbing coating on the front surface of the lens that
attenuates transmitted light;
has a coloured or colourless reflection as seen from the front of the sunglass lens; and
is anti-reflective as seen from the eye side of the lens.

2. An optical lens according to Claim 1, wherein the light absorbing coating functions as a mirror coating.

3. An optical lens that does not substantially distort colour vision including
an optically clear lens element; and
a light absorbing coating on the rear surface of the lens, that
attenuates transmitted light;
has a coloured or colourless reflection as seen from the front of the sunglass lens; and
is anti-reflective as seen from the eye side of the lens.

4. An optical lens according to Claim 3, wherein the light absorbing coating functions as a mirror coating.

5. An optical lens that does not substantially distort colour vision including
an optically clear lens element; and
an asymmetric reflectance, light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the optical lens; and
wherein the asymmetric reflectance, light absorbing coating includes alternating layers of a dielectric material and a metallic material;

the dielectric material being selected from one or more of SiO, SiO_2, ZrO_2, Al_2O_3, TiO, TiO_2, Ti_2O_3, Y_2O_3, Yb_2O_3, MgO, Ta_2O_5, CeO_2 and HfO_2, MgF_2, AlF_3, BaF_2, CaF_2, Na_3AlF_6, Ta_2O_5 and $Na_5Al_3Fl_{14}$, and Si_3N_4 and AlN; and

the metallic material is selected from the metals, metal oxides or nitrides of one or more of Niobium (Nb), Chromium (Cr), Tungsten (W), Tantalum (Ta), Tin (Sn), Palladium (Pd), Nickel (Ni) or Titanium (Ti).

6. An optical lens according to Claim 5, wherein the asymmetric reflectance, light absorbing coating further includes compatible dielectric layers of suitable thickness to provide a desired colour to the optical lens.

7. An optical lens that does not substantially distort colour vision including an optically clear lens element; and

an asymmetric reflectance, light absorbing coating including alternating layers of silica (SiO2) and chromium (Cr) or Niobium (Nb) metal; and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the optical lens.

8. An optical lens according to Claim 7, wherein the asymmetric reflectance, light absorbing coating includes an additional titanium dioxide layer or layers of such a thickness to provide a desired colour to the optical lens.

9. An optical lens according to Claim 10, wherein the asymmetric reflectance, light absorbing coating includes alternating layers of silica and niobium metal and an additional niobium oxide (Nb_2O_5) and/or silica (SiO_2) layer of such thicknesses to provide a desired colour to the optical lens.

10. An optical lens according to Claim 5, wherein a surface of the lens is subjected to a surface treatment.

11. An optical lens according to Claim 10, wherein the surface treatment improves adhesion thereto.

12. An optical lens according to Claim 11, wherein a surface is subjected to a plasma treatment.

13. An optical lens according to Claim 11, wherein an adhesion promoting coating is applied to a surface.

14. A multi-coated optical lens that does not substantially distort colour vision including

an optically clear lens element; and

an asymmetric reflectance, light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the lens; and

an optically clear secondary coating which provides a desirable optical and/or mechanical property to the optical lens.

15. A multi-coated optical lens according to Claim 14, wherein the secondary coating is an abrasion-resistant coating applied to the front surface or eye side surface of the optical lens.

16. A multi-coated optical lens according to Claim 14, wherein the optically clear secondary coating is an anti-reflective coating applied to the eye side surface of the optical lens.

17. A multi-coated optical lens according to Claim 16, further including an abrasion-resistant coating supporting the anti-reflective coating.

18. A multi-coated optical lens according to Claim 17, wherein the abrasion-resistant coating includes an organo-silicone resin.

19. An optical lens element including

a lens wafer having

a first lens surface; and

a second lens surface,
the first or second surface having deposited thereon
a light absorbing coating that
attenuates transmitted light;
has a coloured or colourless reflection as seen from the front of the sunglass lens; and
is anti-reflective as seen from the eye side of the lens; and
does not substantially distort colour vision.

20. An optical lens element according to Claim 19, wherein the light absorbing coating is an asymmetric reflectance light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers; the thickness and/or number of the respective layers being selected to provide a desired colour to the optical lens element and an anti-reflective effect on the eye side of the lens element, when formed as a laminate optical lens.

21. An optical lens element according to Claim 20, wherein the lens wafer is a front lens wafer and the asymmetric reflectance light absorbing coating is deposited on the concave surface of the front lens wafer.

22. An optical lens element according to Claim 20, wherein the lens wafer is a back lens wafer and the asymmetric reflectance light absorbing coating is deposited on the convex surface of the back lens wafer.

23. An optical lens element according to Claim 20, wherein the lens wafer is a back lens wafer and the asymmetric reflectance light absorbing coating is deposited on the concave surface of the back lens wafer.

24. An optical lens element according to Claim 20, wherein the lens wafer is a front lens wafer and the asymmetric reflectance light absorbing coating is deposited on the convex surface of the front lens wafer.

25. A laminate optical lens that does not substantially distort colour vision including

a front lens wafer including

a contact surface;

a complementary back lens wafer including

a contact surface; and

a light absorbing coating deposited on a contact surface, which light absorbing coating

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens.

26. A laminate optical lens according to Claim 25, wherein the light absorbing coating includes a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the lens.

27. A laminate optical lens according to Claim 25, wherein a contact surface of the front and/or back lens wafer bears a mark thereon, the mark not being visible from the eye side of the laminate lens.

28. A laminate optical lens according to Claim 27, wherein the mark on the contact surface is visible from the front surface of the laminate lens.

29. An optical lens element according to Claim 26, wherein the light absorbing coating includes a silica top layer, the silica top layer bearing a mark visible prior to lamination.

30. An optical lens element according to Claim 29 wherein the visible mark is etched into the silica top layer.

31. An optical lens element according to Claim 29 wherein the visible mark is deposited on the silica top layer, the visible mark being formed from a laminate adhesive or polymeric material having a refractive index approximately equal to

that of the silica layer.

32. An optical lens element according to Claim 29, wherein the visible mark is rendered substantially invisible when the lens wafer is contacted with a laminate adhesive having a refractive index approximately equal to that of the silica layer.

33. A method for preparing an optical lens, which method includes providing

an optically clear lens element; and

a light absorbing coating on the front surface of the lens that

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens; and

depositing the light absorbing coating on a surface of the optical lens element.

34. A method according to Claim 33, further including providing

an optically clear lens element,

a light absorbing material, and

a generally transparent material;

depositing overlapping layers of light absorbing material and generally transparent material on a surface of the optical lens element, the number and/or thickness of the respective layers being selected to provide a desired colour to the front surface of the optical lens and an anti-reflective effect on the eye side of the optical lens.

35. A method according to Claim 34, wherein the deposition step is a vacuum deposition step and is conducted in a box coater or sputter coating apparatus.

36. A method according to Claim 35, wherein the optically clear lens element includes

a front lens wafer including

a contact surface,

a complementary back lens wafer, including

a contact surface

and the overlapping layers of light absorbing material and generally transparent material are deposited on a surface of the front and/or complementary back lens wafer.

37. A method according to Claim 36, wherein the overlapping layers of light absorbing material and generally transparent material are deposited on a contact surface of the front or complementary back lens wafer.

38. A method according to Claim 36, wherein a laminate adhesive is applied to one or both contact surfaces, the front lens wafer and back lens wafer being brought into contact and the laminate so formed being subjected to a curing step to form a laminate optical lens.

39. A method according to Claim 38, wherein the top layer of the light absorbing coating is a silica layer bearing a visible mark thereon;

the laminate adhesive having a similar refractive index to the silica layer such that, when the laminate is cured, the mark on the silica surface becomes substantially invisible to the wearer.

40. An optical lens according to Claim 1, substantially as hereinbefore described with reference to any one of the examples.

STATEMENT UNDER ARTICLE 19(1)

Claims 1, 3, 5, 7, 9,14, 19 and 25 have been amended to introduce the feature that the lens does "not substantially distort colour vision".

Claims 5 and 6 have been combined.

Claims 10 and 11 have been combined.

Claims 7 to 42 have been amended and renumbered, and the appendancies have been corrected.

CLAIMS

1. An optical lens including
an optically clear lens element; and
a light absorbing coating on the front surface of the lens that
attenuates transmitted light;
has a coloured or colourless reflection as seen from the front of the sunglass lens; and
is anti-reflective as seen from the eye side of the lens.

2. An optical lens according to Claim 1, wherein the light absorbing coating functions as a mirror coating.

3. An optical lens including
an optically clear lens element; and
a light absorbing coating on the rear surface of the lens, that
attenuates transmitted light;
has a coloured or colourless reflection as seen from the front of the sunglass lens; and
is anti-reflective as seen from the eye side of the lens.

4. An optical lens according to Claim 3, wherein the light absorbing coating functions as a mirror coating.

5. An optical lens including
an optically clear lens element; and
an asymmetric reflectance, light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the optical lens.

6. An optical lens according to Claim 5, wherein the asymmetric reflectance, light absorbing coating includes alternating layers of a dielectric material and a metallic material;

the dielectric material being selected from one or more of SiO, SiO_2, ZrO_2, Al_2O_3, TiO, TiO_2, Ti_2O_3, Y_2O_3, Yb_2O_3, MgO, Ta_2O_5, CeO_2 and HfO_2, MgF_2, AlF_3, BaF_2, CaF_2, Na_3AlF_6, Ta_2O_5 and $Na_5Al_3Fl_{14}$, and Si_3N_4 and AlN; and

the metallic material is selected from the metals, metal oxides or nitrides of one or more of Niobium (Nb), Chromium (Cr), Tungsten (W), Tantalum (Ta), Tin (Sn), Palladium (Pd), Nickel (Ni) or Titanium (Ti).

7. An optical lens according to Claim 5, wherein the asymmetric reflectance, light absorbing coating further includes compatible dielectric layers of suitable thickness to provide a desired colour to the optical lens.

8. An optical lens according to Claim 6, wherein the asymmetric reflectance, light absorbing coating includes alternating layers of silica (SiO_2) and chromium metal.

9. An optical lens according to Claim 8, wherein the asymmetric reflectance, light absorbing coating includes an additional titanium dioxide layer or layers of such a thickness to provide a desired colour to the optical lens.

10. An optical lens according to Claim 6, wherein the asymmetric reflectance, light absorbing coating includes alternating layers of silica and niobium metal.

11. An optical lens according to Claim 10, wherein the asymmetric reflectance, light absorbing coating includes an additional niobium oxide (Nb_2O_5) and/or silica (SiO_2) layer of such thicknesses to provide a desired colour to the optical lens.

12. An optical lens according to Claim 5, wherein a surface of the lens is subjected to a surface treatment.

13. An optical lens according to Claim 12, wherein the surface treatment improves adhesion thereto.

14. An optical lens according to Claim 13, wherein a surface is subjected to a plasma treatment.

15. An optical lens according to Claim 13, wherein an adhesion promoting coating is applied to a surface.

16. A multi-coated optical lens including

an optically clear lens element; and

an asymmetric reflectance, light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the lens; and

an optically clear secondary coating which provides a desirable optical and/or mechanical property to the optical lens.

17. A multi-coated optical lens according to Claim 16, wherein the secondary coating is an abrasion-resistant coating applied to the front surface or eye side surface of the optical lens.

18. A multi-coated optical lens according to Claim 16, wherein the optically clear secondary coating is an anti-reflective coating applied to the eye side surface of the optical lens.

19. A multi-coated optical lens according to Claim 18, further including an abrasion-resistant coating supporting the anti-reflective coating.

20. A multi-coated optical lens according to Claim 19, wherein the abrasion-resistant coating includes an organo-silicone resin.

21. An optical lens element including

a lens wafer having

a first lens surface; and

a second lens surface,

the first or second surface having deposited thereon

a light absorbing coating that

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens.

22. An optical lens element according to Claim 21, wherein the light absorbing coating is an asymmetric reflectance light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers; the thickness and/or number of the respective layers being selected to provide a desired colour to the optical lens element and an anti-reflective effect on the eye side of the lens element, when formed as a laminate optical lens.

23. An optical lens element according to Claim 22, wherein the lens wafer is a front lens wafer and the asymmetric reflectance light absorbing coating is deposited on the concave surface of the front lens wafer.

24. An optical lens element according to Claim 22, wherein the lens wafer is a back lens wafer and the asymmetric reflectance light absorbing coating is deposited on the convex surface of the back lens wafer.

25. An optical lens element according to Claim 22, wherein the lens wafer is a back lens wafer and the asymmetric reflectance light absorbing coating is deposited on the concave surface of the back lens wafer.

26. An optical lens element according to Claim 22, wherein the lens wafer is a front lens wafer and the asymmetric reflectance light absorbing coating is deposited on the convex surface of the front lens wafer.

27. A laminate optical lens including

a front lens wafer including

a contact surface;

a complementary back lens wafer including

a contact surface; and

a light absorbing coating deposited on a contact surface, which light absorbing coating

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens.

28. A laminate optical lens according to Claim 27, wherein the light absorbing coating includes a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the lens.

29. A laminate optical lens according to Claim 27, wherein a contact surface of the front and/or back lens wafer bears a mark thereon, the mark not being visible from the eye side of the laminate lens.

30. A laminate optical lens according to Claim 29, wherein the mark on the contact surface is visible from the front surface of the laminate lens.

31. An optical lens element according to Claim 28, wherein the light absorbing coating includes a silica top layer, the silica top layer bearing a mark visible prior to lamination.

32. An optical lens element according to Claim 31 wherein the visible mark is etched into the silica top layer.

33. An optical lens element according to Claim 31 wherein the visible mark is deposited on the silica top layer, the visible mark being formed from a laminate adhesive or polymeric material having a refractive index approximately equal to that of the silica layer.

34. An optical lens element according to Claim 31, wherein the visible mark is

rendered substantially invisible when the lens wafer is contacted with a laminate adhesive having a refractive index approximately equal to that of the silica layer.

35. A method for preparing an optical lens, which method includes providing

an optically clear lens element; and

a light absorbing coating on the front surface of the lens that

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens; and

depositing the light absorbing coating on a surface of the optical lens element.

36. A method according to Claim 35, further including providing

an optically clear lens element,

a light absorbing material, and

a generally transparent material;

depositing overlapping layers of light absorbing material and generally transparent material on a surface of the optical lens element, the number and/or thickness of the respective layers being selected to provide a desired colour to the front surface of the optical lens and an anti-reflective effect on the eye side of the optical lens.

37. A method according to Claim 36, wherein the deposition step is a vacuum deposition step and is conducted in a box coater or sputter coating apparatus.

38. A method according to Claim 37, wherein the optically clear lens element includes

a front lens wafer including

a contact surface,

a complementary back lens wafer, including

a contact surface

and the overlapping layers of light absorbing material and generally transparent material are deposited on a surface of the front and/or complementary back lens wafer.

39. A method according to Claim 38, wherein the overlapping layers of light absorbing material and generally transparent material are deposited on a contact surface of the front or complementary back lens wafer.

40. A method according to Claim 38, wherein a laminate adhesive is applied to one or both contact surfaces, the front lens wafer and back lens wafer being brought into contact and the laminate so formed being subjected to a curing step to form a laminate optical lens.

41. A method according to Claim 40, wherein the top layer of the light absorbing coating is a silica layer bearing a visible mark thereon;

the laminate adhesive having a similar refractive index to the silica layer such that, when the laminate is cured, the mark on the silica surface becomes substantially invisible to the wearer.

42. An optical lens according to Claim 1, substantially as hereinbefore described with reference to any one of the examples.

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

REC'D 3 JUN 1999

Applicant's or agent's file reference 40118987	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International application No. **PCT/AU 98/00868**	International filing date *(day/month/year)* 19 October 1998	Priority Date *(day/month/year)* 21 October 1997

International Patent Classification (IPC) or national classification and IPC

Int. Cl.[6] G02C 7/10, G02B 1/10, 1/11

Applicant

SOLA INTERNATIONAL HOLDINGS LTD et al.

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 9 sheets, including this cover sheet.

[X] This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 8 sheet(s).

3. This report contains indications relating to the following items:

I	[X]	Basis of the report
II	[ ]	Priority
III	[X]	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	[ ]	Lack of unity of invention
V	[X]	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	[X]	Certain documents cited
VII	[ ]	Certain defects in the international application
VIII	[X]	Certain observations on the international application

Date of submission of the demand 23 March 1999	Date of completion of the report 22 June 1999
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200 WODEN ACT 2606 AUSTRALIA Facsimile No. (02) 6285 3929	Authorized Officer **RAJEEV DESHMUKH** Telephone No. (02) 6283 2145

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/AU 98/00868

I. Basis of the report

1. With regard to the **elements** of the international application:*

   [ ] the international application as originally filed.

   [X] the description, pages **1 - 25**, as originally filed,
   pages , filed with the demand,
   pages , filed with the letter of .

   [X] the claims, pages , as originally filed,
   pages , as amended (together with any statement) under Article 19,
   pages , filed with the demand,
   pages **26 - 33**, filed with the letter of **15 June 1999**.

   [X] the drawings, pages **1 - 11**, as originally filed,
   pages , filed with the demand,
   pages , filed with the letter of .

   [ ] the sequence listing part of the description:
   pages , as originally filed
   pages , filed with the demand
   pages , filed with the letter of

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
   These elements were available or furnished to this Authority in the following language which is:

   [ ] the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
   [ ] the language of publication of the international application (under Rule 48.3(b)).
   [ ] the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, was on the basis of the sequence listing:

   [ ] contained in the international application in written form.
   [ ] filed together with the international application in computer readable form.
   [ ] furnished subsequently to this Authority in written form.
   [ ] furnished subsequently to this Authority in computer readable form.
   [ ] The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
   [ ] The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. [ ] The amendments have resulted in the cancellation of:

   [ ] the description, pages
   [ ] the claims, Nos.
   [ ] the drawings, sheets/fig

5. [ ] This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*
** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report*

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be nonobvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application,

☒ claims Nos.: 44

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination *(specify)*:

☐ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. are so unclear that no meaningful opinion could be formed *(specify)*:

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☒ no international search report has been established for said claim Nos. 44

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims **1 - 43**	**YES**
	Claims	**NO**
Inventive step (IS)	Claims **1 - 43**	**YES**
	Claims	**NO**
Industrial applicability (IA)	Claims **1 - 43**	**YES**
	Claims	**NO**

2. Citations and explanations (Rule 70.7)

D1: WO 96/04216 A (BAUSCH & LOMB INCORPORATED)
D2: US 5407733 A (BJORNARD et al)
D3: US 5135298 A (FELTMAN)
D4: US 4802755 A (HENSLER)
D5: US 4793669 A (PERILLOUX)
D6: US 3990784 A (GELBER)
D7: US 3679291 A (APFEL)

D1 discloses a sunglass lens having improved anti-reflection and transmittance comprising a lens-shaped substrate and a coating formed in the concave surface of the lens. D1 states that for sunglass lenses, it is also important that reflection of visible light at the concave (or rear) lens surface is sufficiently low to avoid glare from incident light at the concave surface. The first layer of the coating deposited adjacent to the concave surface of the lens comprises a titanium suboxide material, the second layer comprises a material having a high refractive index and the third layer comprises a material having a low refractive index.

D2 discloses a coating for an article comprising layers of nitrides of certain transition metals to provide an electrically conductive, light attenuating, anti-reflection surface. In column18, line 32, the coating is said to be suitable for solar control glazing, sunglasses and protective eyewear.

D3 discloses a combination lens for sunglasses which uses a pair of superposed lenses which are laminated together with a polarised light filtering film in between the lenses. Front or anterior lens is a photochromic glass plate with a metallic light reflective coating applied to the inner laminated surface of anterior lens. Rear, or posterior lens has an anti-reflective filter applied to the outer non-laminated surface of the posterior lens.

D4 discloses a sunglass lens wherein a photochromic lens is coated on its front and rear surfaces with a titanium monoxide material. An anti-reflection substance is overlaid onto the titanium monoxide deposited on the rear surface.

D5 discloses a multilayer optical filter for producing coloured reflected light and neutral transmission. The filter may be used as sunglass lenses.

D6 discloses an architectural glass having low inside reflectance.

D7 discloses a filter with neutral transmitting asymmetric reflectance with strong colour on one side. Some embodiments have low reflectance on the other side.

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of : Box V (first continuation sheet)

The agent for the applicant has responded to the written opinion by enclosing a new set of claims and by submitting the following arguments.

In the proposed amendments, inter alia claims 1 to 4 have been deleted and previous claim 5, which the examiner has conceded is novel, has been made the subject of new claim 1. We consider that the citations raised by the examiner are clearly distinguishable from the amended claims and are clearly both novel and exhibit an inventive step thereover for the following reasons.

1 D1 - WO96/04216 (Bausch & Lomb Incorporated)

The examiner has commented on the D1 specification and has pointed out that it discloses a sunglass lens having improved anti-reflection and transmittance performance. Whilst the examiner's comments are correct as far as they go, we respectfully point out that the D1 disclosure is in fact a very narrow disclosure and for that reason is illustrative of the novelty and non-obviousness of the coating system the subject of the present application. Specifically, in order to achieve reasonable optics on a sunglass lens, the D1 specification shows that it is essential to firstly lay down a titanium sub-oxide layer on the concave surface of the lens and then to build up a second and a third layer which are basically a pair of dielectric layers, typically titanium dioxide and magnesium fluoride or silica.

It can be seen from the D1 specification that the difficulties in providing a coating which will adhere to the curved surface of a lens and provide acceptable optics, whilst fulfilling the objective of the coating which is to provide an improvement in non-reflection and transmittance, is indeed a challenging task. In particular, in the present citation, Bausch & Lomb have had to resort to restricting the coating to the concave surface only and using a titanium sub-oxide sub-layer together with a pair of other dielectric layers.

This stands in stark contrast to the coatings the subject of the present invention. By utilising at least four overlapping light-absorbing and generally transparent layers made up of alternating layers of a dielectric and a metallic material, applicants have been able create a coating which both attenuates transmitted light and provides a desirable coloured or colourless (silver or mirror) reflection whilst still being anti-reflective from the eye side of the lens. In contrast, the lenses the subject of the present application have a coating which is clearly distinguishable from that of the D1 specification.

There is a now clear requirement in new claim 1 for at least four layers of alternating dielectric and metallic materials. The claim has been adjusted to clearly distinguish between the dielectric and the metallic materials. In contrast, the D1 specification does not disclose a metallic material of the type claimed in claim 1 as amended of the present application. The optical lens the subject of the present application is also clearly inventive over the D1 specification since it does not utilise the titanium sub-oxide base layer and is not restricted to utilisation of the coating on the concave surface of the lens at all. Indeed, it is preferably applied to the convex surface of the lens. Further, the lens the subject of the present application has a coloured or colourless reflection from the front of the sunglass lens which is generated from the light-absorbing coating. In contrast, the lens the subject of the D1 specification is in fact tinted with a neodymium oxide as the major colorant. Thus, the coating the subject of the present application may be seen as a multi-purpose coating in contrast to that of D1.

2 D2 - US patent 5407733 (Bjornard et al)

The D2 specification is principally concerned with flat glass sheets, for example, for use as a contrast enhancement filter. The disclosure concentrates on creating electrically conductive anti-reflection coatings which are irrelevant in the context of an optical sunglass lens. The coating the subject of D2 is for example the combination of three layers - a silicon dioxide top layer, a titanium dioxide central layer and a base layer of niobium nitride. This may be contrasted with the four alternating layers of dielectrics and metallic materials required in the coating the subject of the present application. Thus the coatings are completely different and for a different purpose and again illustrate the flexibility of the invention the subject of the present application. Again, in the context of inventive step, the coatings the subject of the D2 specification do not address the combined requirements of generating a desirable coloured or colourless (silver) reflection from the front of the lens, the attenuation of transmitted light and anti-reflectivity from the eye side of the lens.

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Box V (second continuation sheet)

The above comments of course ignore the difficulties generated in creating and adhering. a coating on a curved optical lens in contrast to a flat glass sheet. Whilst it is true that there is mention of sunglasses in the D2 specification, there is no recognition of the difficulties inherent in achieving good adhesion between a coating and a curved surface whilst maintaining good optics and good mechanical properties. The D2 specification is clearly silent on all of these characteristics.

3 D3 - US patent 5135298 (Feltman)

The examiner has also cited the Feltman specification, D3. However it is not apparent to the applicant, with respect, what the relevance of the Feltman citation is meant to be. There is no asymmetric reflectance light-absorbing coating disclosed therein. There are in fact two coatings, a metallic light reflective coating (18) and an anti-reflective filter applied to the outer non-laminated surface of the posterior lens (14). Tint is generated via a photochromic glass plate (12). The Feltman specification is, accordingly, most edifying as to the degree of advance provided by the invention the subject of the present application. In order to achieve something similar, it has been necessary for Feltman to produce a complex glass laminate consisting of no less than five components in order to achieve what the applicant in the present application has been able to achieve with two. Our comments in relation to D1 and D2 apply equally to the Feltman specification but we cannot, with respect, agree that Feltman is relevant in the present context.

4 D4 - US patent 4802755 (Hensler)

The Hensler specification describes a dual-purpose sunglass lens having a gold appearance. The lens is a photochromic lens which has a layer of titanium monoxide coated on both front and rear surfaces and an anti-reflection substance overlaid on the rear surface. The anti-reflection substance may be magnesium fluoride. The Hensler specification, D4, is thus a similar disclosure to that of the Feltman specification D3. We have again a complex multi-layer solution to a similar but in fact different problem to that the subject of the present application. The objective of the D4 specification is to achieve a gold appearance to a photochromic lens. This is achieved by utilisation of coatings of titanium monoxide on both front and rear surfaces. As a separate component, an anti-reflection surface is created utilising, for example, magnesium fluoride on the rear surface alone. In contrast, the coating the subject of the present invention is an asymmetric reflectance light-absorbing coating which includes at least four overlapping alternating layers of a dielectric material and a metallic material. Such a metallic material is simply not present in the disclosure in the D4 specification, nor are there four layers designed to set up interference reactions to achieve the objects of the present invention. Moreover, the Hensler disclosure is a very narrow one since it will achieve a gold colour only, whereas adjustment of the number and/or thicknesses of the multi-layer coating the subject of the present invention, permits a range of colours to be selected and created whilst also fulfilling the other requirements of the invention the subject of the present application.

5 D5 - US patent 4793669 (Perilloux)

The Perilloux specification, D5, is basically a multi-layer optical filter including multiple layers of silica and titanium dioxide. Our comments in relation to the earlier citations are equally applicable to the Perilloux citation. The Perilloux citation is filter specific so it is designed to achieve blockage of part of the visible spectrum, rather than achieving the asymmetric reflectance light absorption the subject of the present application. The coatings are clearly distinguishable as no combination of alternating dielectric and metallic materials the subject of the present application are in place. Finally, there is no recognition of the difficulties, let alone provision of the solution, for producing a light-absorbing coating which exhibits asymmetric reflectance on a curved optical lens.

6 D6 - US patent 3990784 (Gelber)

Gelber discloses an architectural glass system with a three-layer coating of two metal layers interposed by a dielectric layer. Once again this is clearly a different system to that described in the present application and does not relate to or address the issues consequent upon application of a coating to a curved optical lens. It is also not a four-layer system of overlapping alternating layers of dielectric material and metallic material as required by the claims of the present invention as proposed to be amended. The Gelber specification is in some way similar to the Perilloux specification where the coating basically functions as a wavelength filter, rather than as generating a colour or colourless reflection to a sunglass lens.

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of : Box V (third continuation sheet)

In addition, it is to be noted that the coating disclosed in the D6 specification is order sensitive. For example, it is disclosed in column 10 that:

> "In the event there is great concern as to the durability of the coating which is placed on the architectural glass substrate 11, the coatings which are shown in FIGS 1 and 2 cannot merely be placed on the inside surface of the architectural glass because the coatings are arranged so that the outer layer is matched to the medium which is air and the inner layer is matched to the substrate."

Thus in the coating the subject of the D6 specification, both the order and relative thicknesses of the coating are dictated by the necessity to work relative to the architectural glass and the air. Moreover, when considering thicknesses, we are of course dealing in D6 with thicknesses which are an order of magnitude greater than are appropriate in the context of an optical lens.

7 D7 - US patent 3679291 (Apfel)

The Apfel specification is very similar to the Gelber specification and the comments made above in relation to Gelber are equally applicable to the Apfel specification. Indeed, Gelber is an inventor in both cases.

In light of the above arguments by the agent for the applicant, the invention defined by the amended claims appears to be novel, to involve an inventive step, and to be industrially applicable.

VI. Certain documents cited

1. Certain published documents (Rule 70.10)

Application No. Patent No.	Publication date *(day/month/year)*	Filing date *(day/month/year)*	Priority date (valid claim) *(day/month/year)*
US 470731 US 5694240 A (STERNBERGH)	2 December 1997	6 June 1995	Continuation-in-part of Ser. No. 265, 183 24 June 1994, abandoned

This document prima facie appears to disclose the claimed invention. STERNBERGH discloses a sunglass having a multi-layer coating on its concave (rear) surface that comprises an absorbing layer and at least one composite layer for reducing transmittance of UV radiation. Reflection of visible light at the concave surface is minimised. The agent for the applicant has not submitted any arguments in relation to the above document.

2. Non-written disclosures (Rule 70.9)

Kind of non-written disclosure	Date of non-written disclosure *(day/month/year)*	Date of written disclosure referring to non-written disclosure *(day/month/year)*

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

1. The applicant was invited to insert into the statement of prior art, references to the documents cited in the international search report, and to discuss the invention with reference to these documents, so as to put the invention into proper perspective. (Rules 5.1 (a)(ii) and 5.1 (a)(iii) of the PCT). The applicant has not amended the description to include such references.

2. There are six independent claims, numbered 1, 5, 13, 21, 27, and 36. This number of claims is not reasonable in consideration of the nature of invention claimed. (PCT Rule 6.1(a))

3. Claims as a whole are not clear because there are six independent claims each with a different set of technical features. It is therefore not clear which set of technical features defines the invention.

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CLAIMS

1. An optical lens including

an optically clear lens element; and

an asymmetric reflectance, light absorbing coating including at least four overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the optical lens; and

wherein the asymmetric reflectance, light absorbing coating includes alternating layers of a dielectric material and a metallic material which is a metal or metal nitride;

2. An optical lens according to Claim 1, wherein

the dielectric material is selected from one or more of SiO, SiO_2, ZrO_2, Al_2O_3, TiO, TiO_2, Ti_2O_3, Y_2O_3, Yb_2O_3, MgO, Ta_2O_5, CeO_2 and HfO_2, MgF_2, AlF_3, BaF_2, CaF_2, Na_3AlF_6, Ta_2O_5 and $Na_5Al_3Fl_{14}$, and Si_3N_4 and AlN; and

the metallic material is selected from the metals, or metal nitrides of one or more of Niobium (Nb), Chromium (Cr), Tungsten (W), Tantalum (Ta), Tin (Sn), Palladium (Pd), Nickel (Ni) or Titanium (Ti).

3. An optical lens according to Claim 1, wherein the asymmetric reflectance, light absorbing coating further includes compatible dielectric layers of suitable thickness to provide a desired colour to the optical lens.

4. An optical lens according to Claim 1, wherein the asymmetric reflectance, light absorbing coating further includes a compatible dielectric top layer to enhance abrasion resistance.

5. An optical lens including

an optically clear lens element; and

an asymmetric reflectance, light absorbing coating including at least four alternating layers of silica (SiO2) and chromium (Cr) or Niobium (Nb) metal; and wherein the thickness and/or number of the respective layers are selected to

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provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the optical lens.

6. An optical lens according to Claim 5, wherein the asymmetric reflectance, light absorbing coating includes an additional titanium dioxide layer or layers of such a thickness to provide a desired colour to the optical lens.

7. An optical lens according to Claim 5, wherein the asymmetric reflectance, light absorbing coating includes alternating layers of silica and niobium metal and an additional niobium oxide (Nb_2O_5) and/or silica (SiO_2) layer of such thicknesses to provide a desired colour to the optical lens.

8. An optical lens according to Claim 1, wherein a surface of the lens is subjected to a surface treatment.

9. An optical lens according to Claim 8, wherein the surface treatment improves adhesion thereto.

10. An optical lens according to Claim 9, wherein a surface is subjected to a plasma treatment.

11. An optical lens according to Claim 9, wherein an adhesion promoting coating is applied to a surface.

12. An optical lens according to Claim 1, wherein the optically clear lens element is a laminate optical lens.

13. A multi-coated optical lens including

an optically clear lens element;

an asymmetric reflectance, light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the lens;

wherein the asymmetric reflectance, light absorbing coating includes alternating layers of a dielectric material and a metallic material which is a metal or metal nitride;

an optically clear secondary coating which provides a desirable optical and/or mechanical property to the optical lens.

14. A multi-coated optical lens according to Claim 13, wherein

the dielectric material is selected from one or more of SiO, SiO_2, ZrO_2, Al_2O_3, TiO, TiO_2, Ti_2O_3, Y_2O_3, Yb_2O_3, MgO, Ta_2O_5, CeO_2 and HfO_2, MgF_2, AlF_3, BaF_2, CaF_2, Na_3AlF_6, Ta_2O_5 and $Na_5Al_3Fl_{14}$, and Si_3N_4 and AlN; and

the metallic material is selected from the metals or metal nitrides of one or more of Niobium (Nb), Chromium (Cr), Tungsten (W), Tantalum (Ta), Tin (Sn), Palladium (Pd), Nickel (Ni) or Titanium (Ti).

15. A multi-coated optical lens according to claim 14, wherein the asymmetric reflectance, light absorbing coating further includes compatible dielectric layers of suitable thickness to provide a desired colour to the optical lens.

16. A multi-coated optical lens according to claim 14, wherein the asymmetric reflectance, light absorbing coating further includes a compatible dielectric top layer to enhance abrasion resistance.

17. A multi-coated optical lens according to Claim 13, wherein the secondary coating is an abrasion-resistant coating applied to the front surface or eye side surface of the optical lens.

18. A multi-coated optical lens according to Claim 13, wherein the optically clear secondary coating is an anti-reflective coating applied to the front surface or eye side surface of the optical lens.

19. A multi-coated optical lens according to Claim 18, further including an abrasion-resistant coating supporting the anti-reflective coating.

20. A multi-coated optical lens according to Claim 19, wherein the abrasion-

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resistant coating includes an organo-silicone resin.

21. An optical lens element including
a lens wafer having
a first lens surface; and
a second lens surface,
the first or second surface having deposited thereon
an asymmetric reflectance, light absorbing coating including at least four overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the optical lens when formed as a laminate optical lens; and
wherein the asymmetric reflectance, light absorbing coating includes alternating layers of a dielectric material and a metallic material which is a metal or metal nitride.

22. An optical lens element according to Claim 21 wherein
the dielectric material is selected from one or more of SiO, SiO_2, ZrO_2, Al_2O_3, TiO, TiO_2, Ti_2O_3, Y_2O_3, Yb_2O_3, MgO, Ta_2O_5, CeO_2 and HfO_2, MgF_2, AlF_3, BaF_2, CaF_2, Na_3AlF_6, Ta_2O_5 and $Na_5Al_3Fl_{14}$, and Si_3N_4 and AlN; and
the metallic material is selected from the metals or metal nitrides of one or more of Niobium (Nb), Chromium (Cr), Tungsten (W), Tantalum (Ta), Tin (Sn), Palladium (Pd), Nickel (Ni) or Titanium (Ti).

23. An optical lens element according to Claim 21, wherein the lens wafer is a front lens wafer and the asymmetric reflectance light absorbing coating is deposited on the concave surface of the front lens wafer.

24. An optical lens element according to Claim 21 wherein the lens wafer is a back lens wafer and the asymmetric reflectance light absorbing coating is deposited on the convex surface of the back lens wafer.

25. An optical lens element according to Claim 21, wherein the lens wafer is a back lens wafer and the asymmetric reflectance light absorbing coating is

deposited on the concave surface of the back lens wafer.

26. An optical lens element according to Claim 21, wherein the lens wafer is a front lens wafer and the asymmetric reflectance light absorbing coating is deposited on the convex surface of the front lens wafer.

27. A laminate optical lens including

a front lens wafer including

a contact surface;

a complementary back lens wafer including

a contact surface; and

an asymmetric reflectance, light absorbing coating deposited on a contact surface, which light absorbing coating includes at least four overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the optical lens; and

wherein the asymmetric reflectance, light absorbing coating includes alternating layers of a dielectric material and a metallic material which is a metal or metal nitride.

28. A laminate optical lens according to Claim 27, wherein

the dielectric material is selected from one or more of SiO, SiO_2, ZrO_2, Al_2O_3, TiO, TiO_2, Ti_2O_3, Y_2O_3, Yb_2O_3, MgO, Ta_2O_5, CeO_2 and HfO_2, MgF_2, AlF_3, BaF_2, CaF_2, Na_3AlF_6, Ta_2O_5 and $Na_5Al_3Fl_{14}$, and Si_3N_4 and AlN; and

the metallic material is selected from the metals, or metal nitrides of one or more of Niobium (Nb), Chromium (Cr), Tungsten (W), Tantalum (Ta), Tin (Sn), Palladium (Pd), Nickel (Ni) or Titanium (Ti).

29. A laminate optical lens according to Claim 27, wherein a contact surface of the front and/or back lens wafer bears a mark thereon, the mark not being visible from the eye side of the laminate lens.

30. A laminate optical lens according to Claim 29, wherein the mark on the

contact surface is visible from the front surface of the laminate lens.

31. An optical lens element according to Claim 27, wherein the light absorbing coating is deposited on a contact surface and includes a silica top layer, the silica top layer bearing a mark visible prior to lamination.

32. An optical lens element according to Claim 31 wherein the visible mark is etched into the silica top layer.

33. An optical lens element according to Claim 32, wherein the visible mark is rendered substantially invisible from the eye side of the laminate lens when the lens wafer is bonded to its complementary wafer with a laminate adhesive having a refractive index approximately equal to that of the silica layer.

34. An optical lens element according to Claim 31 wherein the visible mark is deposited on the silica top layer, the visible mark being formed from a laminate adhesive or polymeric material having a refractive index approximately equal to that of the silica layer.

35. An optical lens element according to Claim 34, wherein the visible mark is rendered substantially invisible from the eye side of the laminate lens when the lens wafer is bonded to its complementary wafer with a laminate adhesive having a refractive index approximately equal to that of the silica layer.

36. A method for preparing an optical lens, including

an optically clear lens element; and

an asymmetric reflectance, light absorbing coating including at least four overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the optical lens; and

wherein the asymmetric reflectance, light absorbing coating includes alternating layers of a dielectric material and a metallic material which is a metal or metal nitride;

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which method includes

providing

an optically clear lens element,

a dielectric material; and

a metallic material;

depositing at least four overlapping layers of dielectric material and metallic material on a surface of the optical lens element, the number and/or thickness of the respective layers being selected to provide an asymmetric reflectance, light absorbing coating.

37. A method according to Claim 36, wherein

the dielectric material is selected from one or more of SiO, SiO_2, ZrO_2, Al_2O_3, TiO, TiO_2, Ti_2O_3, Y_2O_3, Yb_2O_3, MgO, Ta_2O_5, CeO_2 and HfO_2, MgF_2, AlF_3, BaF_2, CaF_2, Na_3AlF_6, Ta_2O_5 and $Na_5Al_3Fl_{14}$, and Si_3N_4 and AlN; and

the metallic material is selected from the metals, or metal nitrides of one or more of Niobium (Nb), Chromium (Cr), Tungsten (W), Tantalum (Ta), Tin (Sn), Palladium (Pd), Nickel (Ni) or Titanium (Ti);

38. A method according to Claim 36, wherein the deposition step is a vacuum deposition step and is conducted in a box coater or sputter coating apparatus.

39. A method according to Claim 36, wherein the optically clear lens element includes

a front lens wafer including

a contact surface,

a complementary back lens wafer, including

a contact surface

and the overlapping layers of dielectric material and metallic material are deposited on a surface of the front and/or complementary back lens wafer.

40. A method according to Claim 39, wherein the overlapping layers of dielectric material and metallic material are deposited on a contact surface of the front or complementary back lens wafer.

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41. A method according to Claim 39, wherein a laminate adhesive is applied to one or both contact surfaces, the front lens wafer and back lens wafer being brought into contact and the laminate so formed being subjected to a curing step to form a laminate optical lens.

42. A method according to claim 41, wherein the contact surface bearing the light absorbing coating bears a visible mark thereon;

the laminate adhesive having a similar refractive index to the silica layer such that, when the laminate is bonded, the mark on the contact surface becomes substantially invisible to the wearer.

43. A method according to Claim 41, wherein the top layer of the light absorbing coating is a silica layer bearing a visible mark thereon;

the laminate adhesive having a similar refractive index to the silica layer such that, when the laminate is bonded, the mark on the silica surface becomes substantially invisible to the wearer.

44. An optical lens according to Claim 1, substantially as hereinbefore described with reference to any one of the examples.

[redacted]

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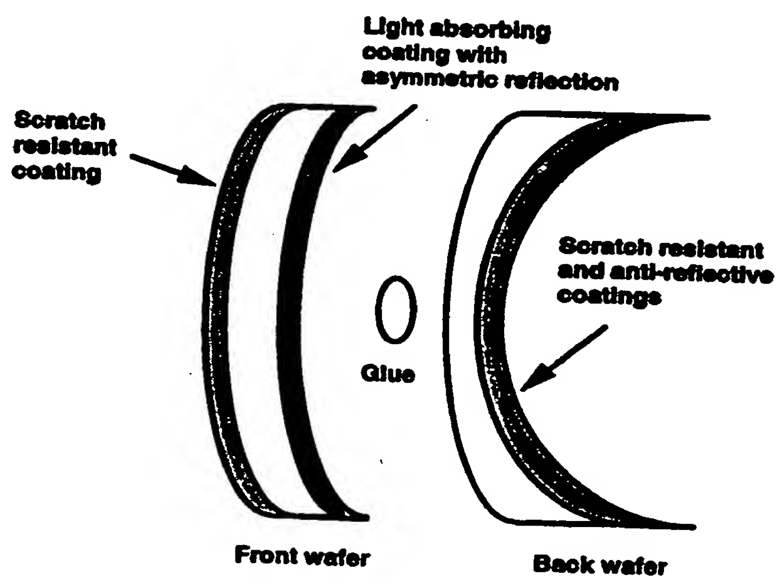
Published
With international search report.
With amended claims and statement.

(54) Title: COATED SUNGLASS LENS

(57) Abstract

An optical lens including an optically clear lens element; and a light absorbing coating on a surface of the lens that attenuates transmitted light; has a coloured or colourless reflection as seen from the front of the sunglass lens; and is anti-reflective as seen from the eye side of the lens.



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COATED SUNGLASS LENS

The present invention relates to optical articles bearing a light absorbing coating.

The optical articles according to the present invention are preferably employed in the preparation of articles such as optical lenses, including spectacle lenses, including sunglass lenses, visors, shields, glass sheets, protective screens, and the like.

Sunglasses generally serve to attenuate transmitted light, but aside from the level of light transmittance, there are other features that distinguish different sunglass lenses, such as material, transmitted colour, scratch resistance, reduction of side glare, ultra-violet transmittance, cosmetic appearance etc. Coatings may be applied to enhance the performance of sunglass lenses. Such coatings might include scratch resistant coatings, hydrophobic coatings for easier cleaning, anti-reflection coatings on the concave surface for reducing side glare or "mirror" (or "interference") coatings for producing fashionable lens colours. General purpose sunglass lenses should meet certain standard specifications, including luminous transmittance, traffic signal recognition and UV transmittance (e.g. ANSI Z80.1-1995).

In addition to their performance characteristics, sunglass lenses should be simple and economical to produce in a reliable manner.

As is known in the prior art, the preferred method for producing sunglass lenses is dependent on the material involved. In all cases a light-attenuating material is either incorporated into the substrate material or applied over its surface in a process known as "tinting". For example, glass lenses are often tinted by introducing coloured additives to the molten glass, and similarly polycarbonate lenses are injection-moulded from pre-coloured plastic granules. A disadvantage associated with this method of production is that for economical reasons, very large batches of coloured raw material must be purchased , limiting flexibility in the range of tint colours that can be offered in the sunglass lens product. Moreover,

prescription sunglass lenses with highly varying thickness will also exhibit non-uniform transmittance when coloured in this way. Hard resin lenses (another commonly used ophthalmic plastic) are usually dipped in a hot, liquid dye which is imbibed into the plastic. This process also has disadvantages, such as difficulty in achieving tint uniformity, poor colour reproducibility and its requirement that if the lens has a scratch resistant coating, it must be semi-permeable to allow imbibation of the dye molecules, hence compromising the scratch resistance. If a reflective mirror coating is desired, the tinted substrate is then cleaned and coated in an evaporative box coater. Such multi-stage processes are both time-consuming and expensive.

One proposal in the prior art to overcome some of the problems associated with lens tinting is to apply the light absorbing material as a thin film on an essentially transparent substrate. United States Patent No. 5,770,259 (Parker and Soane) describes a method for tinting sunglass lenses using a curable primer containing a tinting agent. Vacuum deposition allows the light absorbing coating to be applied in a relatively fast, clean, flexible and controllable manner. United States Patent No. 5,729,323 (Arden and Cumbo) describes a sunglass formed by depositing a multi-layer light absorbing coating containing TiO_x (x=0.2-1.5) on the concave surface of the substrate. The coating is anti-reflective from the wearer's side of the lens. United States Patent No. 3679291 (Apfel and Gelber) describes a metal-dielectric multi-layer coating that is light absorbing and has an asymmetric reflectance, being anti-reflective from one side and with strong colour on the other side.

Another time-consuming step in the production of corrective sunglass lenses is the surfacing of the lenses. Corrective (or prescription) sunglass lenses are often dispensed using "semi-finished blanks" - lenses that have a pre-moulded front surface and a back surface that must be ground and polished to satisfy the individual wearer's corrective prescription. For plastic lenses in particular, tinting and the deposition of further lens coatings must be performed after surfacing the lens, resulting in a long and labour-intensive process to produce and deliver the sunglass lenses. One means to simplify and accelerate lens delivery is to employ

a wafer lamination scheme, where front and back lens wafers spanning a large range of optical powers are simply glued together to produce a lens of virtually any desired prescription. Instead of maintaining a complex optical grinding and polishing workshop, the optical dispenser need only maintain an inventory of wafers and a lamination unit. The use of fast curing glues allows lenses to be produced in only minutes. Additional performance enhancing coatings may be applied to the wafers at the factory, so that the dispenser may provide the desired product features immediately, simply by selecting the appropriate wafers from his inventory.

For laminated lens wafer systems, for example of the Sola International Matrix®-type, liquid bath tinting is not a desired option - it is a low yield process involving significant handling and possible distortion of fragile wafers. Such tinted lenses may also exhibit poor abrasion and scratch resistance and variable depth of colour.

Moreover, for sunglass lenses in particular, it would be a significant advance in the art if, in addition, reflection of visible light at the concave (or rear) lens surface could be kept sufficiently low to avoid glare from incident light at the concave surface.

Accordingly, it is an object of the present invention to overcome, or at least alleviate, one or more of the difficulties or deficiencies related to the prior art.

Accordingly, in a first aspect of the present invention there is provided an optical lens including

an optically clear lens element; and

a light absorbing coating on the front surface of the lens that

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens.

It will be understood that, in accordance with the present invention, one or

more surfaces of an optical lens is coated with a light absorbing coating. This light absorbing coating may be applied to either the outside surface of the lens or an inside surface of a lens wafer (where it is protected from scratching once the wafers are laminated) as discussed below. The light absorbing coating may preferably serve three purposes at once - to attenuate transmitted light, effectively providing the sunglass "tint," to produce a reflected colour that is of pleasing appearance and to reduce or minimise back reflections seen by a wearer of the sunglass lenses.

In a preferred form, the light absorbing coating may function as a mirror coating. Thus, the tinting and mirror coating processes may be combined into one with this coating.

Further the deposited coating may exhibit much improved adhesion and thus improved abrasion resistance.

In a further aspect of the present invention there is provided an optical lens including

an optically clear lens element; and

a light absorbing coating on the rear surface of the lens, such that the light absorbing coating

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens.

Preferably the light absorbing coating is an asymmetric reflectance, light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the lens.

By the term "coloured or colourless reflection", as used herein, we mean that light from a white fluorescent source is reflected from the surface of the

optical lens to an observer such that the reflected light is coloured or white respectively.

By the term "asymmetric reflectance", as used herein, we mean that the multi-layer coating renders the lens anti-reflective when viewed from one side of the coating and exhibits a selected colour or colourless reflection when viewed from the other side.

The optically clear lens element may be a sunglass lens, ophthalmic lens element, visor or the like. A sunglass lens is preferred.

By the term "ophthalmic lens element", as used herein, we mean all forms of individual refractive optical bodies employed in the ophthalmic arts, including, but not limited to, lenses, lens wafers and semi-finished lens blanks requiring further finishing to a particular patient's prescription.

Where the optically clear lens element is an ophthalmic lens element, the ophthalmic lenses may be formed from a variety of different lens materials, and particularly from a number of different polymeric plastic resins. A common ophthalmic lens material is diethylene glycol bis (allyl carbonate). Lens materials with higher refractive indices are now growing in popularity. One such material is a CR39 (PPG Industries). Other high index lens materials are based on acrylic or allylic versions of bisphenols or allyl phthalates and the like. Other examples of lens materials that may be suitable for use with the invention include other acrylics, other allylics, styrenics, polycarbonates, vinylics, polyesters and the like.

The light absorbing coating may be formed from overlapping light absorbing and generally transparent layers, as discussed above. Desirably the light absorbing coating is formed from alternating transparent and absorbing layers.

The number and/or thickness of the light absorbing and generally transparent layers may be selected to provide an eye side anti-reflective coating utilising suitable computer software.

The combination of light absorbing and transparent layers may be selected to provide a bright, coloured reflection when viewed from the front of the lens at the same time. A mirror type coating may be produced.

The transparent layers may be formed from any suitable optically clear material. The transparent layers may be formed of a dielectric material. Preferably the dielectric layers may be formed from metal oxides, fluorides or nitrides. Metal oxides which may be used for forming transparent layers include one or more of SiO, SiO_2, ZrO_2, Al_2O_3, TiO, TiO_2, Ti_2O_3, Y_2O_3, Yb_2O_3, MgO, Ta_2O_5, CeO_2 and HfO_2. Fluorides which may be used include one or more of MgF_2, AlF_3, BaF_2, CaF_2, Na_3AlF_6, Ta_2O_5, and $Na_5Al_3Fl_{14}$. Suitable nitrides include Si_3N_4 and AlN.

A silica (SiO_2) material is preferred.

In a particularly preferred embodiment, the first deposited layer may be a silica layer followed by alternating light absorbing and generally transparent, preferably silica, layers. The transparent dielectric layers may be substantially thicker than the light absorbing or metallic layers. The first layer may be of approximately 10 to 75 nm, preferably approximately 25 to 60 nm. This first layer may provide significant improvement in the abrasion resistance of the multi-layer coating.

The generally transparent layers within the body of the light absorbing coating may be relatively thick. The thicknesses may be such as to generate interference effects which substantially cancel out internal reflections. Thicknesses of for example from approximately 20 nm to 100 nm, preferably approximately 25 nm to 85 nm may be used.

The light absorbing layers of the light absorbing coating may be formed from any suitable material. Metals, metal oxides or nitrides may be used.

Desirably a metallic layer may be selected to provide a generally neutral, e.g. grey transmission. Accordingly a silver-coloured metal, e.g. Niobium (Nb), Chromium (Cr), Tungsten (W), Tantalum (Ta), Tin (Sn), Palladium (Pd), Nickel (Ni)

or Titanium (Ti) or mixtures thereof may be used.

The thickness of the light absorbing layers is such as to attenuate transmitted light. The light absorbing or metallic layers may generally be of a substantially reduced thickness relative to the transparent or dielectric layers. For example if the material used is Niobium, the light absorbing layers may be from approximately 1 nm to 10 nm, preferably approximately 2 nm to 5 nm in thickness.

In a preferred form, the light absorbing coating may include a total of 4 to 12 alternating light absorbing-generally transparent layers, preferably 6 to 8 alternating layers. An additional primer layer may be included, as discussed above.

The resultant coating may exhibit a silver (colourless) mirror-type appearance. Alternatively the light absorbing coating may be modified to produce a different colour coating. For example a metallic oxide, e.g. silica or niobium oxide coating may be applied. A combination of dielectric top coatings may be applied., A silica top coat may be added to modify colour and additionally enhance abrasion resistance.

Accordingly in a preferred form, the light absorbing coating includes alternating layers of a dielectric material and a metallic material;

the dielectric material being selected from one or more of SiO, SiO_2, ZrO_2, Al_2O_3, TiO, TiO_2, Ti_2O_3, Y_2O_3, Yb_2O_3, MgO, Ta_2O_5, CeO_2 and HfO_2, MgF_2, AlF_3, BaF_2, CaF_2, Na_3AlF_6, Ta_2O_5 and $Na_5Al_3Fl_{14}$; and Si_3N_4 and AlN; and

the metallic material is selected from the metals, metal oxides or nitrides of one or more of Niobium (Nb), Chromium (Cr), Tungsten (W), Tantalum (Ta), Tin (Sn), Palladium (Pd), Nickel (Ni) or Titanium (Ti).

More preferably the light absorbing coating includes alternating layers of silica (SiO_2) and chromium metal.

More preferably the light absorbing coating includes an additional titanium dioxide layer or layers of such a thickness to provide a desired colour to the

optical lens.

Alternatively, the light absorbing coating includes alternating layers of silica and niobium metal.

Preferably the light absorbing coating includes an additional niobium oxide (Nb_2O_5) and/or silica (SiO_2) layer of such thicknesses to provide a desired colour to the optical lens.

In a still further preferred embodiment the light absorbing coating further includes compatible dielectric layers of suitable thickness to provide a desired colour to the optical lens.

The optical lens may further include one or more additional coatings.

Accordingly in a further aspect of the present invention there is provided a multi-coated optical lens including

an optical article; and

a light-absorbing coating deposited on at least one surface of the optically clear article; the light-absorbing coating including a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers being selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the optical lens, and

an optically clear secondary coating which provides a desirable optical and/or mechanical property to the optical article.

The optically clear secondary coating may preferably underlay or overlay the light absorbing coating.

The secondary coating may be of any suitable type. The secondary coating may be one or more of an anti-reflective, abrasion resistant, or impact-resistant coating. An abrasion-resistant coating is preferred. The combination of an abrasion resistant coating and an anti-reflective coating is particularly

preferred.

An abrasion-resistant (hard) coating including an organosilicone resin is preferred. A typical organosilicone resin that is suitable for use in the present invention has a composition comprising one or more of the following:

1) organosilane compounds with functional and/or non-functional groups such as glycidoxypropyl trimethoxy silane;
2) co-reactants for functional groups of functional organosilanes, such as organic epoxies, amines, organic acids, organic anhydrides, imines, amides, ketamines, acrylics, and isocyanates; colloidal silica, sols and/or metal and non-metal oxide sols; catalysts for silanol condensation, such as dibutylin dilaurate;
3) solvents such as water, alcohols, and ketones;
4) other additives, such as fillers.

Abrasion resistant coats of acrylic, urethane, melamine, and the like may also be used. These materials, however, frequently do not have the good abrasion resistant properties of organo-silicone hard coatings.

The abrasion-resistant (hard) coating may be coated by conventional methods such as dip coating, spray coating, spin coating, flow coating and the like or by newer methods such as Plasma Enhanced Chemical Vapour Deposition. Coating thicknesses of between approximately 0.5 and 10 microns are preferred for abrasion and other properties.

The secondary abrasion resistant coating may be applied to the front and/or rear lens surfaces. The abrasion resistant coating may be of the type described in United States Patent 4,954,591 to the Applicants, the entire disclosure of which is incorporated herein by reference.

In a preferred aspect, one or both surfaces of the optical article may be subjected to a surface treatment to improve bondability and/or compatibility of the light absorbing and/or secondary coating. The surface treatment may be selected from one or more of the group consisting of plasma discharge, corona discharge,

glow discharge, ionising radiation, UV radiation, flame treatment and laser, preferably excimer laser treatment. A plasma discharge treatment is preferred. The surface treatment, alternatively or in addition, may include incorporating another bonding layer, for example a layer including a metal or metal compound selected from the group consisting of one or more of Chromium, Nickel, Tin, Palladium, Silicon, and/or oxides thereof.

The optical article may be a sunglass lens of the wrap-around or visor type, for example of the type described in International Patent Application PCT/AU97/00188 "Improved Single Vision Lens" to Applicants, the entire disclosure of which is incorporated herein by reference.

In a further aspect of the present invention, there is provided a method for preparing an optical lens, which method includes

providing

an optically clear lens element; and

a light absorbing coating on the front surface of the lens that

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens; and

depositing the light absorbing coating on a surface of the optical lens element.

According to the present invention it has been found that, following the method mentioned above, it is possible to achieve a relatively thin, light absorbing coating with consequent advantages in both optical and mechanical properties.

Preferably the method further includes

providing

an optically clear lens element,

a light absorbing material, and

a generally transparent material;

depositing overlapping layers of light absorbing material and generally

transparent material on a surface of the optical lens element, the number and/or thickness of the respective layers being selected to provide a desired colour to the front surface of the optical lens and an anti-reflective effect on the eye side of the optical lens.

In a preferred aspect the light absorbing or metallic material and generally transparent or dielectric material, preferably Nb and SiO_2 or Cr and SiO_2, are deposited as alternating layers.

The deposition step may be a vacuum deposition step. The deposition step may be conducted in a coating apparatus. A box coater or sputter coater may be used.

The light absorbing coating may preferably be formed on the surfaces of the substrate according to the process and the box coaters as described in the Italian Patent No. 1.244.374 the entire disclosure of which is incorporated herein by reference.

In accordance with said method, the various layers of the light absorbing coating may be deposited in subsquent steps utilising a vacuum evaporation technique and exposing the growing layers to a bombardment of a beam of ions of inert gas.

Moreover, in accordance with the preferred method, the deposition of the layers may be achieved at a low temperature (generally below 80°C), using an ion beam having a medium intensity (meaning the average number of ions that reach the substrate) included beween approximately 30 and 100 μA/cm2 and the energy included between approximately 50 and 100 eV.

Preferably, the optical article is maintained at an elevated temperature during the deposition of the various layers of the light absorbing coating.

More preferably the optically clear lens element includes
a front lens wafer including

a contact surface,

a complementary back lens wafer, including

a contact surface

and the overlapping layers of light absorbing material and generally transparent material are deposited on a surface of the front and/or complementary back lens wafer.

A laminate adhesive may be applied to one or both contact surfaces, the front lens wafer and back lens wafer being brought into contact and the laminate so formed being subjected to a curing step to form a laminate optical lens.

In a further preferred aspect of the present invention, there is provided an optical lens element including

a lens wafer having

a first lens surface; and

a second lens surface,

the first or second surface having deposited thereon

a light absorbing coating that

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens.

Preferably the light absorbing coating is an asymmetric reflectance light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers; the thickness and/or number of the respective layers being selected to provide a desired colour to the optical lens element and an anti-reflective effect on the eye side of the lens element after lamination of the lens wafer.

The coated lens wafer may be a front surface wafer or a rear surface wafer. Where the coated lens wafer is a front surface wafer the light absorbing coating may be deposited on the first (front) or second (rear) lens surface thereof.

Where the coated lens wafer is a rear surface wafer, the light absorbing coating is preferably deposited on the first (front) surface thereof.

Accordingly in a still further aspect of the present invention, there is provided a laminate optical lens including

a front lens wafer including

a contact surface;

a complementary back lens wafer including

a contact surface; and

a light absorbing coating deposited on a contact surface, which light absorbing coating

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens.

Preferably the light absorbing coating includes a plurality of overlapping light absorbing and generally transparent layers; the thickness and/or number of the respective layers being selected to provide a desired colour to the laminate optical lens and an anti-reflective effect on the eye side of the laminate optical lens, as discussed above.

It will be understood that, in this embodiment, in addition to the advantages of the present invention described above, the light absorbing coating provided may be protected by the optical lens wafers themselves and is thus virtually indestructible.

In addition, abrasion resistant and like coatings of the type described above may be applied to the external surfaces of the laminate optical article.

The laminate optical article may be fabricated in a manner similar to that described in International Patent Application PCT/AU96/00805, "Laminate Article", to Applicants, the entire disclosure of which is incorporated herein by reference.

Where the light absorbing coating is applied inside the laminate, particularly for hard resin lenses, because the lens is not tinted in a liquid bath, the scratch resistant coating applied to the exterior of the wafers does not need to be semi-permeable (to allow passage of the tint molecules through to the substrate). Therefore, the most durable, non-tintable scratch resistant coatings may be applied and the final product is extremely durable. The light absorbing coating is protected inside the laminate and cannot be scratched. Because the light absorbing coating is located approximately in the centre of the laminate, when the lens is edged for mounting into spectacle frames, the edges appear "dark" and it is difficult to discern that the "tinted" appearance of the lens is due only to a very thin coating. Finally, as can be seen in Figure 2 below, there is a double reflection from the front of the lens, one "white" reflection from the front of the front wafer and one coloured reflection from the light absorbing coating inside the laminate. If the front wafer is thin and has no optical power, the two reflections overlay one another and only a single reflection is observed. However, if the front wafer is thick and has surfaces of different curvature, then the two front reflections become apparent. A quite pleasing "glossy" effect is obtained.

Before the lens wafers of the laminate lens are bonded, they may be too thin to meet United States F.D.A impact requirements. A sunglass wearer may be put at risk if he wears sunglasses which have been made using only the front or back wafer of the laminate. It may be necessary for a prescription sunglass manufacturer to ensure that non-laminated wafers are not mounted in sunglass frames for general use. One way to achieve this end is to ensure that the lens wafers are visibly identified with a warning symbol as unsuitable for use, in such a way that after the wafers are laminated, the warning is no longer visible. For example, the current Matrix® lens lamination system includes a warning symbol in the centre of the contact surface of each lens wafer - a roughened area of the surface that causes unacceptable disturbance of the wearer's vision and thus effectively prevents use of non-laminated wafers alone in spectacles. However, when the wafers are laminated using an adhesive of refractive index suitably matched to the lens material, the interface corresponding to the roughened surfaces optically disappears, so that the warning symbol is no longer visible.

If the light absorbing coating is applied over such a roughened contact surface, it is visible from the front of the wafer. It is also visible from the back of the wafer, because until the wafer is laminated, it is exposed to air rather than another lens wafer, so the coating does not perform antireflectively as designed. The roughened surface causes substantial light scattering toward the wearer and significantly disturbs his vision, so much so that the front lens wafer would not conceivably be used in a non-laminated state as a sunglass lens. After lamination, the coating is antireflective when viewed from the rear - light scattering from the roughened surface is very weak and so the roughened area is invisible to the wearer. If the contact surface of the lens wafer is roughened in a cosmetically pleasing fashion, then not only are non laminated lens wafers clearly identified, but after the coated wafers are laminated, a logo that is visible from the front of the lens but yet does not disturb the wearer's vision results.

Accordingly, in a preferred embodiment of the present invention a contact surface of the front and/or back lens wafer bears a mark thereon, the mark being substantially visible from both sides of the wafer before lamination, but which becomes substantially invisible from the eye side of the finished laminate lens. Preferably the mark on the contact surface is visible from the front of the laminated lens.

In an alternative embodiment where the mark on the contact surface is not visible from the front of the final laminated lens, the light absorbing coating includes a silica top layer, the silica top layer bearing a mark visible prior to lamination, as discussed above.

Preferably the visible mark is rendered substantially invisible when the lens wafer is contacted with a laminate adhesive having a refractive index approximately equal to that of the silica layer.

The light absorbing coating may for example be purposefully constructed to have a top layer of silica, which has a refractive index of approximately n=1.47. An excimer laser or other etching technique can be applied to remove (or merely reduce the thickness of) the top silica layer of part of the coating in the form of a

warning label, which will be very visible before the wafer is laminated. However, after lamination, glue will fill the depressions caused by the etching, and because the glue can be chosen to have a refractive index very close to that of silica, the etched markings will have no optical effect and hence disappear, making the laminated lens suitable for use.

Alternatively, instead of removing part of the top silica layer, a warning label may be deposited on top of the silica layer with a suitably index-matched material, for example an adhesive or polymer material. Again, after lamination, glue will fill the void around the raised warning label, and because the glue can be chosen to have a refractive index very close to that of silica and the label itself, the warning marking will have no optical effect and hence disappear, making the laminated lens suitable for use.

Further characteristics and advantages of the present invention will be apparent from the following description of drawings and examples of embodiments of the present invention, given as indicative but not restrictive.

In the figures:

Figure 1 illustrates an embodiment of a sunglass lens according to the present invention with the light absorbing coating inside the laminate.

Figure 2 illustrates the attenuation of transmitted light through the sunglass lens of Figure 1 from a forward light source.

Figure 3 illustrates the attenuation of reflected light from the sunglass lens of Figure 1 from side glare.

Figure 4 illustrates the transmission spectra of a “black” laminated lens (see Table 1), as compared to a typical liquid-dye tinted hard resin sunglass lens.

Figure 5 illustrates an embodiment of a laminated sunglass lens with semi-visible internal markings.

Figure 6 illustrates an embodiment of a sunglass lens according to the present invention with the light absorbing coating on the outside surface of the front wafer.

Figure 7 illustrates the attenuation of transmitted light through the sunglass lens of Figure 6 from a forward light source.

Figure 8 illustrates the attenuation of reflected light from the sunglass lens of Figure 6 from side glare.

Figure 9 illustrates an embodiment of a sunglass lens according to the present invention with the light absorbing coating on the outside surface of the back wafer.

Figure 10 illustrates the attenuation of transmitted light through the sunglass lens of Figure 9 from a forward light source.

Figure 11 illustrates the attenuation of reflected light from the sunglass lens of Figure 8 from side glare.

EXAMPLE 1

Light absorbing coating on the inside of a laminated lens

Figure 1 shows a preferred embodiment of a tinted optical lens according to the present invention. The front and back lens wafers are hard resin plastic wafers from a commercial ophthalmic lens system (Sola International Matrix® system). The back lens wafer is supplied with its external surface pre-coated with a scratch resistant and anti-reflective coating. The external surface of the front wafer is also treated with a scratch resistant coating. The internal surfaces of both wafers are of uncoated hard resin.

A light absorbing coating with asymmetric reflectance is applied to the interface surface of the front wafer. (It may equally well be applied to the internal

surface of the back wafer instead. Only the first case will be discussed for simplicity.) The coating is designed so that when the wafers are laminated, neutral attenuation of transmitted light, an aesthetically pleasing colour when viewed from the front of the lens and anti-reflection from the wearer-side of the lens result, as shown in Figures 2 and 3. Referring to Figure 3, it will be appreciated that possible reflections from surfaces behind the light absorbing coating do not contribute in any significant manner, because their intensity is severely reduced by the incident light having initially passed through the light absorbing coating. Such reflections are therefore not indicated in the figure.

The multi-layer light absorbing coatings consist of layers of absorbing materials and transparent dielectrics. The layers of absorbing material provide the attenuation of transmitted light. The degree of attenuation is controlled by adjusting the total thickness of these layers. If the absorbing material has a neutral transmission spectrum (as do many metals), the transmission of the coating will also be neutral, which is highly desirable for a sunglass lens that does not distort colour vision. By appropriately selecting the thicknesses of the various layers (which today is commonly achieved with the aid of computer software packages), the reflectance of the coating may be designed to have the required properties of a pleasing colour when viewed from the front of the lens and anti-reflection from the wearer side.

Table 1 lists the materials and layer thicknesses used in three differently coloured embodiments of the light absorbing coating. The coatings were deposited using a commercial evaporative box coater (Satis 1200).

TABLE 1

Layers			Thickness (nm)		
Number	Material	Primary function	Bronze	Blue	Black
Substrate					
1	Cr	Adhesion to substrate	0.5	0.5	0.5
2	TiO_2	Front colour	37	35	20
3	SiO_2	Front colour	9	50	20
4	TiO_2	Front colour	88	-	20
5	Cr	Absorption	14	12	12
6	SiO_2	Back AR	65	65	65
7	Cr	Absorption	9	9	9
8	SiO_2	Back AR	85	85	85
9	Cr	Absorption	2.5	2.5	2.5
10	SiO_2	Scratch resistance	5	5	5

Table 1. Composition of three differently coloured embodiments of the light absorbing coating as deposited inside the laminated sunglass lens.

The sequence of layers is relative to a light ray entering the front surface of the optical lens.

Table 2 shows the optical performance of the sunglass lenses in transmittance.

TABLE 2

Transmission	Bronze	Blue	Black
Luminous transmittance (%)	12.1	11.4	13.5
CIE x coordinate (illum. C)	0.36	0.38	0.37
CIE y coordinate (illum. C)	0.35	0.37	0.35
Av. UVB transmittance (%)	0	0	0
Av. UVA transmittance (%)	1.8	1.4	2.2
Red traffic signal trans. (%)	16.3	16.3	18.1
Yellow traffic signal trans. (%)	13.6	13.3	15.3
Green traffic signal trans. (%)	11.1	10.1	12.3
ANSI Standard Z80.3 - 1997	yes	yes	yes

Table 2. Optical performance of the sunglass lenses in transmission.

As shown in Figure 4, where the transmission spectrum of the black-coloured sunglass lens is compared to a hard resin sunglass lens tinted by the traditional liquid dye tinting process, the light absorbing coating has a quite neutral transmission, which provides excellent colour vision.

Table 3 shows the reflectance characteristics of the laminated sunglass lenses. As seen from the wearer-side reflectances, the sunglass lenses are indeed quite anti-reflective of side glare.

TABLE 3

Sunglass lens reflectance	Bronze	Blue	Black
Front side			
Luminous reflectance (%)	8.6	15.8	4.5
CIE coordinate (illuminant C), x	0.36	0.23	0.26
CIE coordinate (illuminant C), y	0.35	0.23	0.24
Wearer side			
Luminous reflectance (%)	0.9	1.0	1.1
CIE coordinate (illuminant C), x	0.30	0.25	0.26
CIE coordinate (illuminant C), y	0.31	0.24	0.29

Table 3. Optical performance of the sunglass lenses in reflection.

EXAMPLE 2

In the embodiment of the present invention illustrated in Example 1 (with the light absorbing coating inside the laminate), it is possible to produce semi-visible markings or logos on the sunglass lenses, as shown in Figure 5. By artificially roughening the surface of the wafer on the interface surface underneath the light absorbing coating (for example by etching the mould from which the internal surface of the front wafer is cast in this case), patterns are created and embedded inside the lens after lamination. The roughened surface is visible from the front of the sunglass lens, because from this side of the light absorbing coating, the reflectance is non-negligible, so light is scattered from the roughened surface. From the wearer side, because the coating is anti-reflective, reflections from the roughened surface are extremely weak, so that the markings are almost impossible to see. Therefore the logo can even be placed in the optical centre of the lens without disturbing the wearer's vision.

EXAMPLE 3

Light absorbing coating on the outside surface of the front wafer of a laminated lens

Figure 6 shows another preferred embodiment of the sunglass lens. Again, the front and back lens wafers are hard resin plastic wafers from a commercial ophthalmic lens system (Sola International Matrix® system). The back wafer is supplied with its external surface pre-coated with a scratch resistant and anti-reflective coating. The external surface of the front wafer is also treated with a scratch resistant coating. The internal surfaces of both wafers are of uncoated hard resin.

In this embodiment, the light absorbing coating with asymmetric reflectance is applied to the outside surface of the front wafer. Neutral attenuation of transmitted light, an aesthetically pleasing colour when viewed from the front of the lens and anti-reflection from the wearer-side of the lens again result after the wafers are laminated, as shown in Figures 7 and 8.

Table 4 lists the materials and approximate layer thicknesses used in four differently coloured embodiments of the light absorbing coating. The coatings in this case were deposited using a thin film sputter deposition system.

TABLE 4

Layers			Thickness (nm)			
Number	Material	Primary function	Silver	Gold	Blue	Copper
Substrate						
1	SiO_2	Scratch resistance	50	50	50	50
2	Nb	Absorption	2	2	2	2
3	SiO_2	Back AR	80	80	80	80
4	Nb	Absorption	4	4	4	4
5	SiO_2	Back AR	80	80	65	65
6	Nb	Absorption	4	4	4	4
7	SiO_2	Back AR	40	40	20	40
8	Nb	Absorption	4	4	4	4
9	SiO_2	Back AR, front colour		10	40	10
10	Nb_2O_5	Front colour		10	30	30
11	SiO_2	Front colour	25	30	30	60

Table 4. Composition of four differently coloured embodiments of the light absorbing coating as deposited on the outside surface of the front lens wafer.

Table 5 shows the optical performance of the sunglass lenses in transmittance.

TABLE 5

Transmission	Silver	Gold	Blue	Copper
Luminous transmittance (%)	13.2	15.8	17.6	21.8
CIE x coordinate (illum. C)	0.33	0.33	0.36	0.33
CIE y coordinate (illum. C)	0.33	0.33	0.36	0.34
Av. UVB transmittance (%)	0.0	0.0	1.0	0.3
Av. UVA transmittance (%)	1.3	1.3	2.2	4.8
Red traffic signal trans. (%)	15.2	18.0	22.3	24.8
Yellow traffic signal trans. (%)	14.0	16.6	19.5	23.0
Green traffic signal trans. (%)	12.7	15.3	16.3	21.1
ANSI Standard Z80.3 - 1997	yes	yes	yes	yes

Table 5. Optical performance of the sunglass lenses in transmission.

Table 6 shows the reflectance characteristics of the laminated sunglass lenses. As seen from the wearer-side reflectances, the sunglass lenses are indeed quite anti-reflective of side glare.

TABLE 6

Sunglass lens reflectance	Silver	Gold	Blue	Copper
Front side				
Luminous reflectance (%)	15.4	11.0	17.8	5.6
CIE coordinate (illuminant C), x	0.32	0.35	0.23	0.35
CIE coordinate (illuminant C), y	0.33	0.37	0.23	0.34
Wearer side				
Luminous reflectance (%)	0.98	1.3	1.2	1.8
CIE coordinate (illuminant C), x	0.22	0.23	0.22	0.24
CIE coordinate (illuminant C), y	0.20	0.21	0.25	0.22

Table 6. Optical performance of the sunglass lenses in reflection.

EXAMPLE 4

Light absorbing coating on the outside surface of the back wafer of a laminated lens

In the embodiment the light absorbing coating is deposited on the outside surface of the back wafer as in Figure 9. In this embodiment of the present invention, no additional anti-reflective coating is required to minimise all back reflections to the eye of the wearer, as seen in Figure 11. It will be appreciated that possible reflections from surfaces behind the light absorbing coating do not contribute in any significant manner, because their intensity is severely reduced by the incident light having initially passed through the light absorbing coating. Such reflections are therefore not indicated in the figure.

CLAIMS

1. An optical lens including
an optically clear lens element; and
a light absorbing coating on the front surface of the lens that
attenuates transmitted light;
has a coloured or colourless reflection as seen from the front of the sunglass lens; and
is anti-reflective as seen from the eye side of the lens.

2. An optical lens according to Claim 1, wherein the light absorbing coating functions as a mirror coating.

3. An optical lens including
an optically clear lens element; and
a light absorbing coating on the rear surface of the lens, that
attenuates transmitted light;
has a coloured or colourless reflection as seen from the front of the sunglass lens; and
is anti-reflective as seen from the eye side of the lens.

4. An optical lens according to Claim 3, wherein the light absorbing coating functions as a mirror coating.

5. An optical lens including
an optically clear lens element; and
an asymmetric reflectance, light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the optical lens.

6. An optical lens according to Claim 5, wherein the asymmetric reflectance, light absorbing coating includes alternating layers of a dielectric material and a metallic material;

the dielectric material being selected from one or more of SiO, SiO_2, ZrO_2, Al_2O_3, TiO, TiO_2, Ti_2O_3, Y_2O_3, Yb_2O_3, MgO, Ta_2O_5, CeO_2 and HfO_2, MgF_2, AlF_3, BaF_2, CaF_2, Na_3AlF_6, Ta_2O_5 and $Na_5Al_3Fl_{14}$, and Si_3N_4 and AlN; and

the metallic material is selected from the metals, metal oxides or nitrides of one or more of Niobium (Nb), Chromium (Cr), Tungsten (W), Tantalum (Ta), Tin (Sn), Palladium (Pd), Nickel (Ni) or Titanium (Ti).

7. An optical lens according to Claim 5, wherein the asymmetric reflectance, light absorbing coating further includes compatible dielectric layers of suitable thickness to provide a desired colour to the optical lens.

8. An optical lens according to Claim 6, wherein the asymmetric reflectance, light absorbing coating includes alternating layers of silica (SiO_2) and chromium metal.

9. An optical lens according to Claim 8, wherein the asymmetric reflectance, light absorbing coating includes an additional titanium dioxide layer or layers of such a thickness to provide a desired colour to the optical lens.

10. An optical lens according to Claim 6, wherein the asymmetric reflectance, light absorbing coating includes alternating layers of silica and niobium metal.

11. An optical lens according to Claim 10, wherein the asymmetric reflectance, light absorbing coating includes an additional niobium oxide (Nb_2O_5) and/or silica (SiO_2) layer of such thicknesses to provide a desired colour to the optical lens.

12. An optical lens according to Claim 5, wherein a surface of the lens is subjected to a surface treatment.

13. An optical lens according to Claim 12, wherein the surface treatment improves adhesion thereto.

14. An optical lens according to Claim 13, wherein a surface is subjected to a plasma treatment.

15. An optical lens according to Claim 13, wherein an adhesion promoting coating is applied to a surface.

16. A multi-coated optical lens including

an optically clear lens element; and

an asymmetric reflectance, light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the lens; and

an optically clear secondary coating which provides a desirable optical and/or mechanical property to the optical lens.

17. A multi-coated optical lens according to Claim 16, wherein the secondary coating is an abrasion-resistant coating applied to the front surface or eye side surface of the optical lens.

18. A multi-coated optical lens according to Claim 16, wherein the optically clear secondary coating is an anti-reflective coating applied to the eye side surface of the optical lens.

19. A multi-coated optical lens according to Claim 18, further including an abrasion-resistant coating supporting the anti-reflective coating.

20. A multi-coated optical lens according to Claim 19, wherein the abrasion-resistant coating includes an organo-silicone resin.

21. An optical lens element including

a lens wafer having

a first lens surface; and

a second lens surface,

the first or second surface having deposited thereon

a light absorbing coating that

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens.

22. An optical lens element according to Claim 21, wherein the light absorbing coating is an asymmetric reflectance light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers; the thickness and/or number of the respective layers being selected to provide a desired colour to the optical lens element and an anti-reflective effect on the eye side of the lens element, when formed as a laminate optical lens.

23. An optical lens element according to Claim 22, wherein the lens wafer is a front lens wafer and the asymmetric reflectance light absorbing coating is deposited on the concave surface of the front lens wafer.

24. An optical lens element according to Claim 22, wherein the lens wafer is a back lens wafer and the asymmetric reflectance light absorbing coating is deposited on the convex surface of the back lens wafer.

25. An optical lens element according to Claim 22, wherein the lens wafer is a back lens wafer and the asymmetric reflectance light absorbing coating is deposited on the concave surface of the back lens wafer.

26. An optical lens element according to Claim 22, wherein the lens wafer is a front lens wafer and the asymmetric reflectance light absorbing coating is deposited on the convex surface of the front lens wafer.

27. A laminate optical lens including

a front lens wafer including

a contact surface;

a complementary back lens wafer including

a contact surface; and

a light absorbing coating deposited on a contact surface, which light absorbing coating

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens.

28. A laminate optical lens according to Claim 27, wherein the light absorbing coating includes a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the lens.

29. A laminate optical lens according to Claim 27, wherein a contact surface of the front and/or back lens wafer bears a mark thereon, the mark not being visible from the eye side of the laminate lens.

30. A laminate optical lens according to Claim 29, wherein the mark on the contact surface is visible from the front surface of the laminate lens.

31. An optical lens element according to Claim 28, wherein the light absorbing coating includes a silica top layer, the silica top layer bearing a mark visible prior to lamination.

32. An optical lens element according to Claim 31 wherein the visible mark is etched into the silica top layer.

33. An optical lens element according to Claim 31 wherein the visible mark is deposited on the silica top layer, the visible mark being formed from a laminate adhesive or polymeric material having a refractive index approximately equal to that of the silica layer.

34. An optical lens element according to Claim 31, wherein the visible mark is

rendered substantially invisible when the lens wafer is contacted with a laminate adhesive having a refractive index approximately equal to that of the silica layer.

35. A method for preparing an optical lens, which method includes providing

an optically clear lens element; and

a light absorbing coating on the front surface of the lens that

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens; and

depositing the light absorbing coating on a surface of the optical lens element.

36. A method according to Claim 35, further including providing

an optically clear lens element,

a light absorbing material, and

a generally transparent material;

depositing overlapping layers of light absorbing material and generally transparent material on a surface of the optical lens element, the number and/or thickness of the respective layers being selected to provide a desired colour to the front surface of the optical lens and an anti-reflective effect on the eye side of the optical lens.

37. A method according to Claim 36, wherein the deposition step is a vacuum deposition step and is conducted in a box coater or sputter coating apparatus.

38. A method according to Claim 37, wherein the optically clear lens element includes

a front lens wafer including

a contact surface,

a complementary back lens wafer, including

a contact surface

and the overlapping layers of light absorbing material and generally transparent material are deposited on a surface of the front and/or complementary back lens wafer.

39. A method according to Claim 38, wherein the overlapping layers of light absorbing material and generally transparent material are deposited on a contact surface of the front or complementary back lens wafer.

40. A method according to Claim 38, wherein a laminate adhesive is applied to one or both contact surfaces, the front lens wafer and back lens wafer being brought into contact and the laminate so formed being subjected to a curing step to form a laminate optical lens.

41. A method according to Claim 40, wherein the top layer of the light absorbing coating is a silica layer bearing a visible mark thereon;

the laminate adhesive having a similar refractive index to the silica layer such that, when the laminate is cured, the mark on the silica surface becomes substantially invisible to the wearer.

42. An optical lens according to Claim 1, substantially as hereinbefore described with reference to any one of the examples.

AMENDED CLAIMS
[received by the International Bureau on 14 December 1998 (14.12.98); original claims 1-42 replaced by amended claims 1-40 (7 pages)]

1. An optical lens that does not substantially distort colour vision including
an optically clear lens element; and
a light absorbing coating on the front surface of the lens that
attenuates transmitted light;
has a coloured or colourless reflection as seen from the front of the sunglass lens; and
is anti-reflective as seen from the eye side of the lens.

2. An optical lens according to Claim 1, wherein the light absorbing coating functions as a mirror coating.

3. An optical lens that does not substantially distort colour vision including
an optically clear lens element; and
a light absorbing coating on the rear surface of the lens, that
attenuates transmitted light;
has a coloured or colourless reflection as seen from the front of the sunglass lens; and
is anti-reflective as seen from the eye side of the lens.

4. An optical lens according to Claim 3, wherein the light absorbing coating functions as a mirror coating.

5. An optical lens that does not substantially distort colour vision including
an optically clear lens element; and
an asymmetric reflectance, light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the optical lens; and
wherein the asymmetric reflectance, light absorbing coating includes alternating layers of a dielectric material and a metallic material;

the dielectric material being selected from one or more of SiO, SiO_2, ZrO_2, Al_2O_3, TiO, TiO_2, Ti_2O_3, Y_2O_3, Yb_2O_3, MgO, Ta_2O_5, CeO_2 and HfO_2, MgF_2, AlF_3, BaF_2, CaF_2, Na_3AlF_6, Ta_2O_5 and $Na_5Al_3Fl_{14}$, and Si_3N_4 and AlN; and

the metallic material is selected from the metals, metal oxides or nitrides of one or more of Niobium (Nb), Chromium (Cr), Tungsten (W), Tantalum (Ta), Tin (Sn), Palladium (Pd), Nickel (Ni) or Titanium (Ti).

6. An optical lens according to Claim 5, wherein the asymmetric reflectance, light absorbing coating further includes compatible dielectric layers of suitable thickness to provide a desired colour to the optical lens.

7. An optical lens that does not substantially distort colour vision including

an optically clear lens element; and

an asymmetric reflectance, light absorbing coating including alternating layers of silica (SiO2) and chromium (Cr) or Niobium (Nb) metal; and

wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the optical lens.

8. An optical lens according to Claim 7, wherein the asymmetric reflectance, light absorbing coating includes an additional titanium dioxide layer or layers of such a thickness to provide a desired colour to the optical lens.

9. An optical lens according to Claim 10, wherein the asymmetric reflectance, light absorbing coating includes alternating layers of silica and niobium metal and an additional niobium oxide (Nb_2O_5) and/or silica (SiO_2) layer of such thicknesses to provide a desired colour to the optical lens.

10. An optical lens according to Claim 5, wherein a surface of the lens is subjected to a surface treatment.

11. An optical lens according to Claim 10, wherein the surface treatment improves adhesion thereto.

12. An optical lens according to Claim 11, wherein a surface is subjected to a plasma treatment.

13. An optical lens according to Claim 11, wherein an adhesion promoting coating is applied to a surface.

14. A multi-coated optical lens that does not substantially distort colour vision including

an optically clear lens element; and

an asymmetric reflectance, light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the lens; and

an optically clear secondary coating which provides a desirable optical and/or mechanical property to the optical lens.

15. A multi-coated optical lens according to Claim 14, wherein the secondary coating is an abrasion-resistant coating applied to the front surface or eye side surface of the optical lens.

16. A multi-coated optical lens according to Claim 14, wherein the optically clear secondary coating is an anti-reflective coating applied to the eye side surface of the optical lens.

17. A multi-coated optical lens according to Claim 16, further including an abrasion-resistant coating supporting the anti-reflective coating.

18. A multi-coated optical lens according to Claim 17, wherein the abrasion-resistant coating includes an organo-silicone resin.

19. An optical lens element including

a lens wafer having

a first lens surface; and

a second lens surface,

the first or second surface having deposited thereon

a light absorbing coating that

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens; and

does not substantially distort colour vision.

20. An optical lens element according to Claim 19, wherein the light absorbing coating is an asymmetric reflectance light absorbing coating including a plurality of overlapping light absorbing and generally transparent layers; the thickness and/or number of the respective layers being selected to provide a desired colour to the optical lens element and an anti-reflective effect on the eye side of the lens element, when formed as a laminate optical lens.

21. An optical lens element according to Claim 20, wherein the lens wafer is a front lens wafer and the asymmetric reflectance light absorbing coating is deposited on the concave surface of the front lens wafer.

22. An optical lens element according to Claim 20, wherein the lens wafer is a back lens wafer and the asymmetric reflectance light absorbing coating is deposited on the convex surface of the back lens wafer.

23. An optical lens element according to Claim 20, wherein the lens wafer is a back lens wafer and the asymmetric reflectance light absorbing coating is deposited on the concave surface of the back lens wafer.

24. An optical lens element according to Claim 20, wherein the lens wafer is a front lens wafer and the asymmetric reflectance light absorbing coating is deposited on the convex surface of the front lens wafer.

25. A laminate optical lens that does not substantially distort colour vision including

a front lens wafer including

a contact surface;

a complementary back lens wafer including

a contact surface; and

a light absorbing coating deposited on a contact surface, which light absorbing coating

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens.

26. A laminate optical lens according to Claim 25, wherein the light absorbing coating includes a plurality of overlapping light absorbing and generally transparent layers, and wherein the thickness and/or number of the respective layers are selected to provide an anti-reflective effect on the eye side of the optical lens and a desired colour on the other side of the lens.

27. A laminate optical lens according to Claim 25, wherein a contact surface of the front and/or back lens wafer bears a mark thereon, the mark not being visible from the eye side of the laminate lens.

28. A laminate optical lens according to Claim 27, wherein the mark on the contact surface is visible from the front surface of the laminate lens.

29. An optical lens element according to Claim 26, wherein the light absorbing coating includes a silica top layer, the silica top layer bearing a mark visible prior to lamination.

30. An optical lens element according to Claim 29 wherein the visible mark is etched into the silica top layer.

31. An optical lens element according to Claim 29 wherein the visible mark is deposited on the silica top layer, the visible mark being formed from a laminate adhesive or polymeric material having a refractive index approximately equal to

that of the silica layer.

32. An optical lens element according to Claim 29, wherein the visible mark is rendered substantially invisible when the lens wafer is contacted with a laminate adhesive having a refractive index approximately equal to that of the silica layer.

33. A method for preparing an optical lens, which method includes

providing

an optically clear lens element; and

a light absorbing coating on the front surface of the lens that

attenuates transmitted light;

has a coloured or colourless reflection as seen from the front of the sunglass lens; and

is anti-reflective as seen from the eye side of the lens; and

depositing the light absorbing coating on a surface of the optical lens element.

34. A method according to Claim 33, further including

providing

an optically clear lens element,

a light absorbing material, and

a generally transparent material;

depositing overlapping layers of light absorbing material and generally transparent material on a surface of the optical lens element, the number and/or thickness of the respective layers being selected to provide a desired colour to the front surface of the optical lens and an anti-reflective effect on the eye side of the optical lens.

35. A method according to Claim 34, wherein the deposition step is a vacuum deposition step and is conducted in a box coater or sputter coating apparatus.

36. A method according to Claim 35, wherein the optically clear lens element includes

a front lens wafer including

a contact surface,

a complementary back lens wafer, including

a contact surface

and the overlapping layers of light absorbing material and generally transparent material are deposited on a surface of the front and/or complementary back lens wafer.

37. A method according to Claim 36, wherein the overlapping layers of light absorbing material and generally transparent material are deposited on a contact surface of the front or complementary back lens wafer.

38. A method according to Claim 36, wherein a laminate adhesive is applied to one or both contact surfaces, the front lens wafer and back lens wafer being brought into contact and the laminate so formed being subjected to a curing step to form a laminate optical lens.

39. A method according to Claim 38, wherein the top layer of the light absorbing coating is a silica layer bearing a visible mark thereon;

the laminate adhesive having a similar refractive index to the silica layer such that, when the laminate is cured, the mark on the silica surface becomes substantially invisible to the wearer.

40. An optical lens according to Claim 1, substantially as hereinbefore described with reference to any one of the examples.

STATEMENT UNDER ARTICLE 19(1)

Claims 1, 3, 5, 7, 9,14, 19 and 25 have been amended to introduce the feature that the lens does "not substantially distort colour vision".

Claims 5 and 6 have been combined.

Claims 10 and 11 have been combined.

Claims 7 to 42 have been amended and renumbered, and the appendancies have been corrected.

FIGURE 1

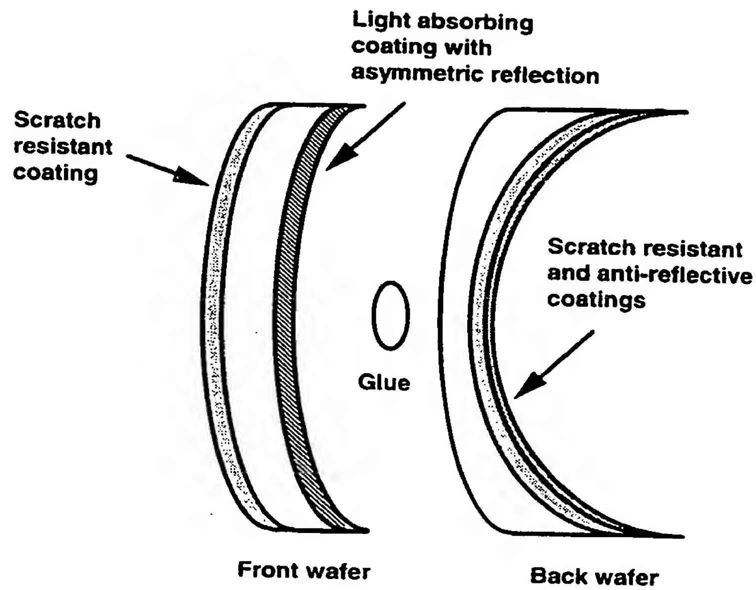

Light absorbing
coating with
asymmetric reflection
Scratch
resistant
coating
Scratch resistant
and anti-reflective
coatings
Glue
Front wafer
Back wafer

FIGURE 2

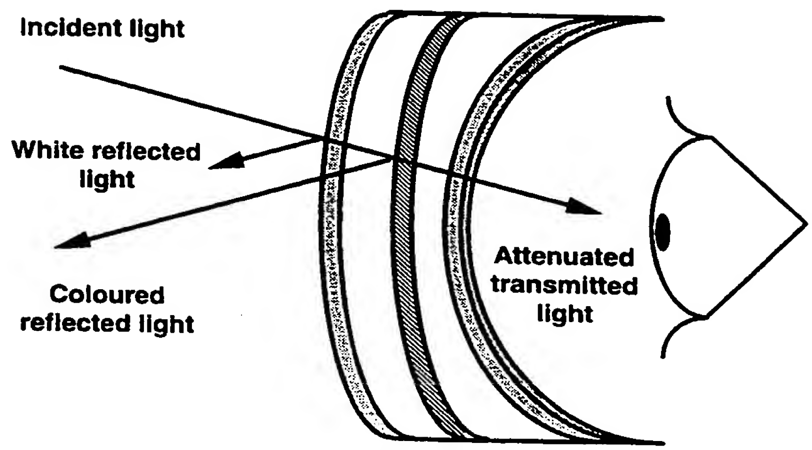

Incident light
White reflected light
Coloured reflected light
Attenuated transmitted light

FIGURE 3

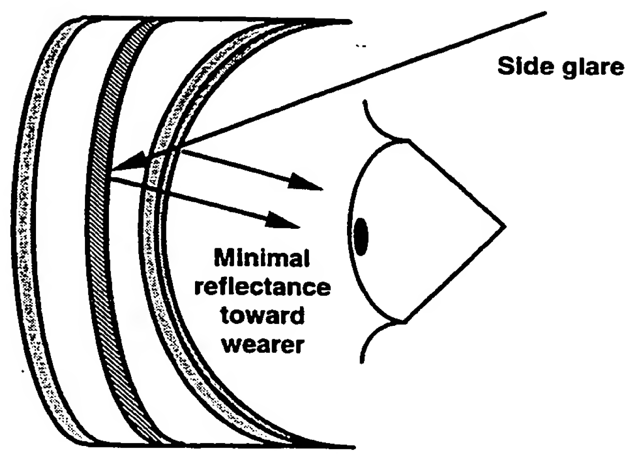
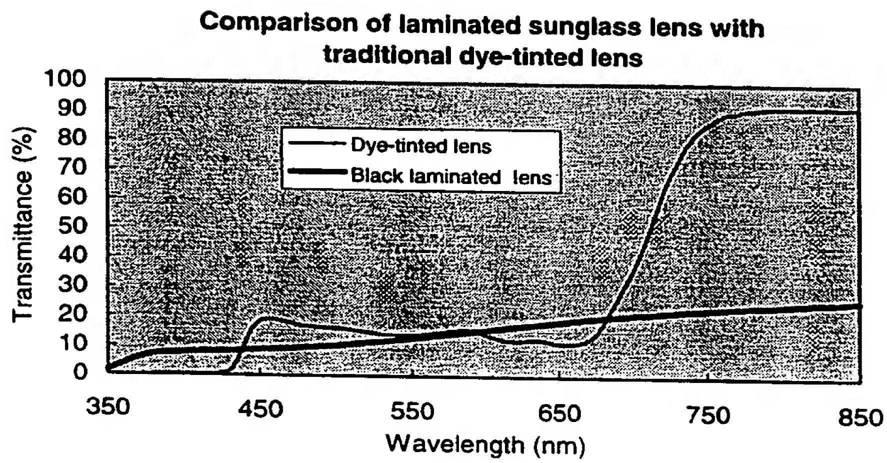


FIGURE 4



Comparison of laminated sunglass lens with traditional dye-tinted lens
Transmittance (%)
100
90
80
70
60
50
40
30
20
10
0
Dye-tinted lens
Black laminated lens
350
450
550
650
750
850
Wavelength (nm)

FIGURE 5

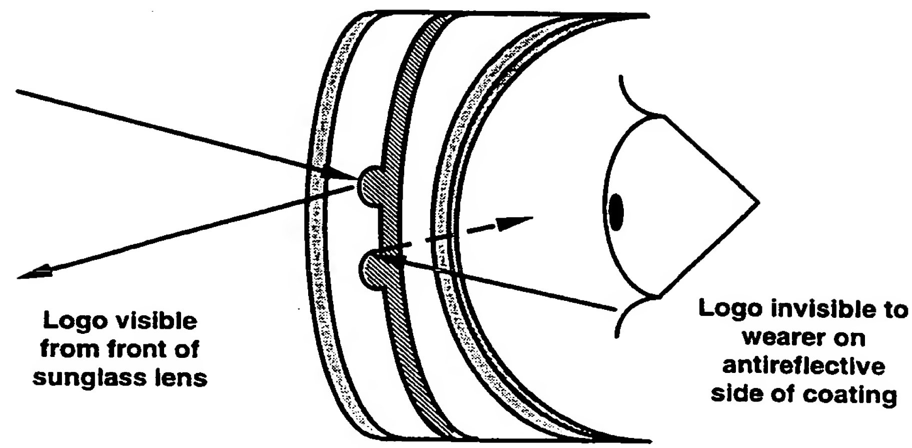

Logo visible from front of sunglass lens
Logo invisible to wearer on antireflective side of coating

FIGURE 6

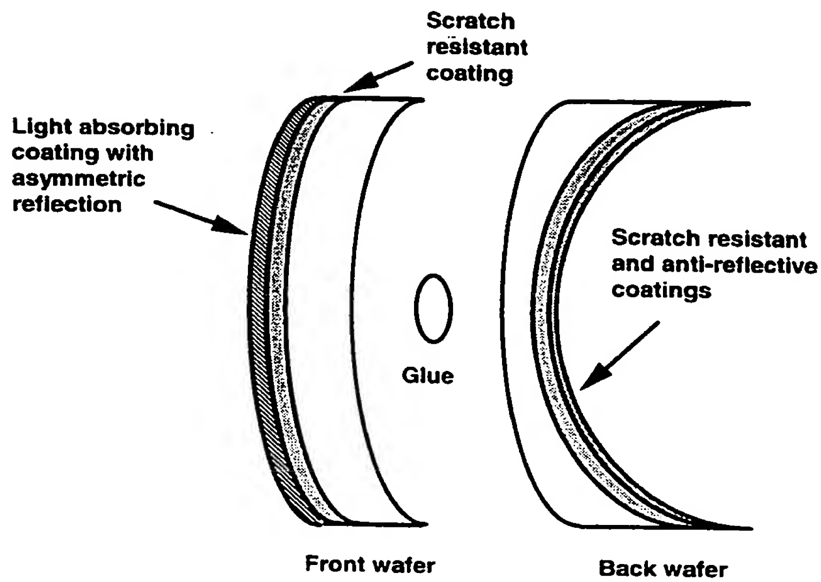

Scratch resistant coating
Light absorbing coating with asymmetric reflection
Scratch resistant and anti-reflective coatings
Glue
Front wafer
Back wafer

FIGURE 7

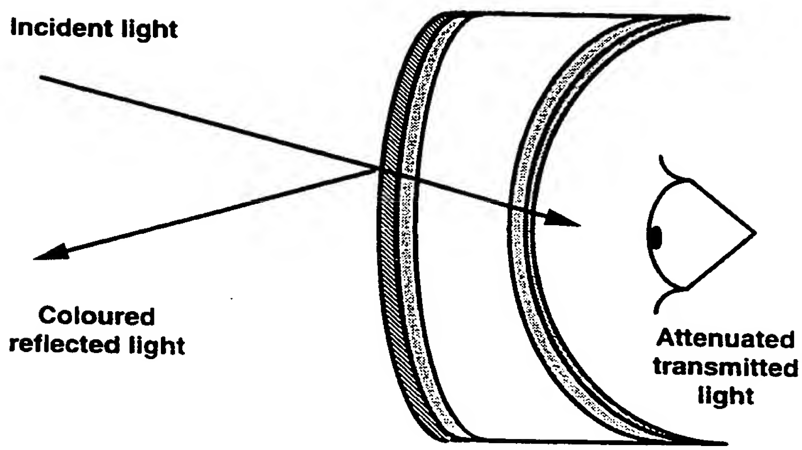

Incident light
Coloured reflected light
Attenuated transmitted light

FIGURE 8

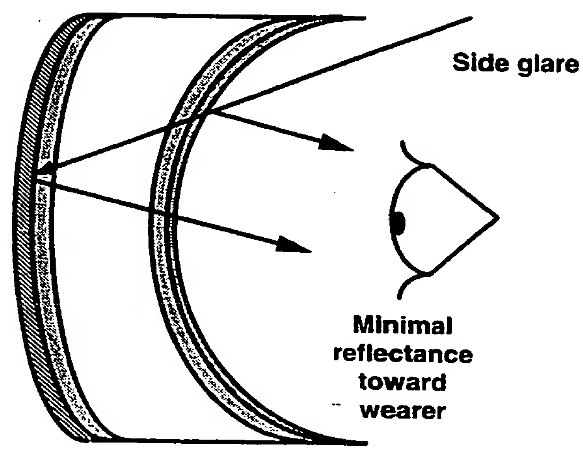


FIGURE 9

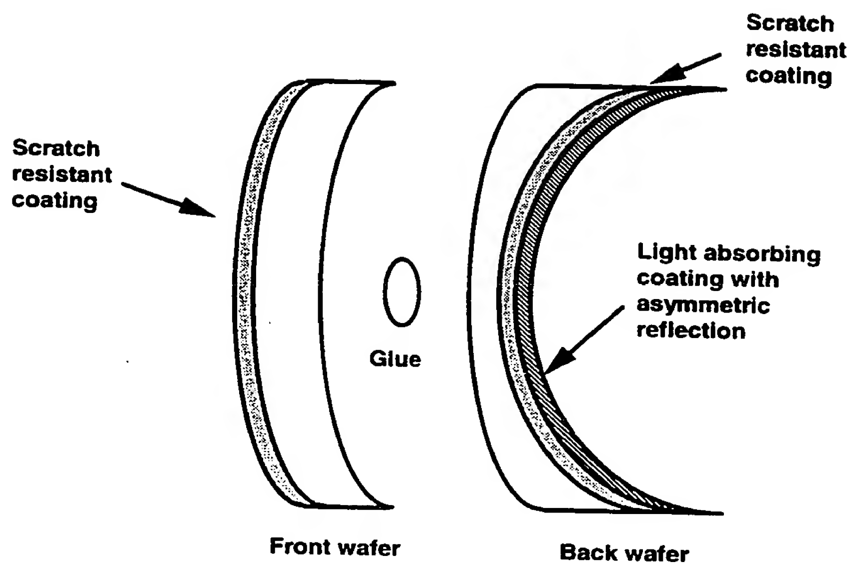

Scratch resistant coating
Scratch resistant coating
Light absorbing coating with asymmetric reflection
Glue
Front wafer
Back wafer

FIGURE 10

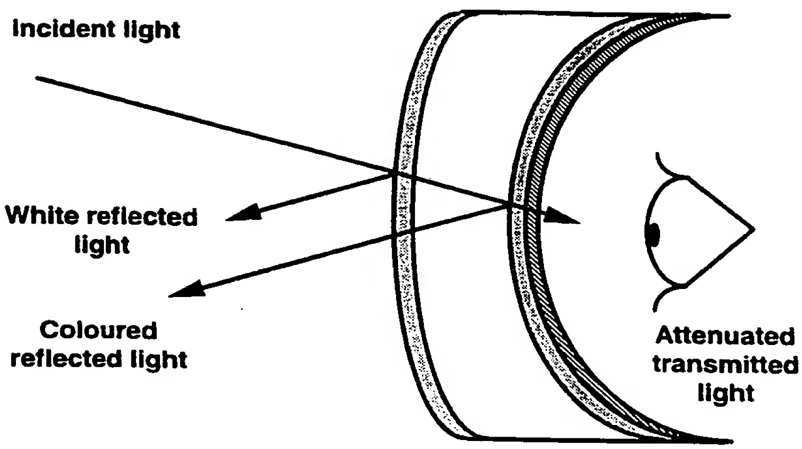

Incident light
White reflected light
Coloured reflected light
Attenuated transmitted light

FIGURE 11